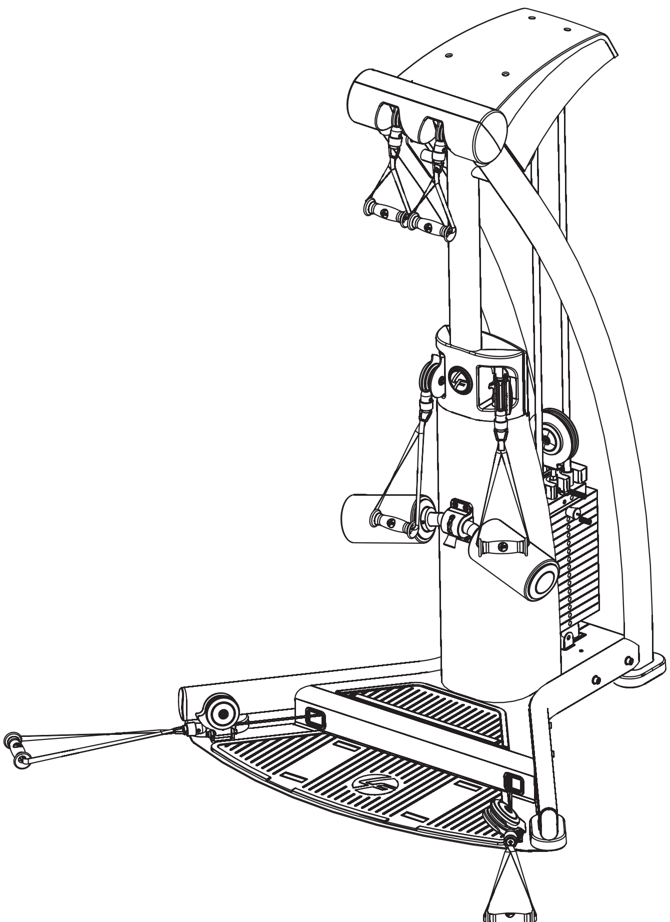
APPENDIX U

G5 CABLE MOTION™ GYM SYSTEM

ASSEMBLY INSTRUCTIONS

G5-001 / CLASS H / 09/30/08 / 8289201 REV. B



Life Fitness
WHAT WE LIVE FOR

Nautilus Exhibit 1007

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SAFETY INFORMATION

It is the sole responsibility of the purchaser of LIFE FITNESS products to read the owner's manual, warning labels and instruct all individuals, whether they are the end user or supervising personnel on proper usage of the equipment.

UNDERSTANDING EACH AND EVERY WARNING TO THE FULLEST IS IMPORTANT. IF ANY OF THESE INSTRUCTIONS OR WARNINGS ARE UNCLEAR, CONTACT LIFE FITNESS CUSTOMER SERVICE IMMEDIATELY AT 1-800-351-3737 WITHIN THE US AND CANADA. INTERNATIONAL OFFICE CONTACT INFORMATION IS AVAILABLE ON PAGE 24.

Keep children away from strength equipment. Parent or others supervising children must provide close supervision of children if the equipment is used in the presence of children.

This equipment is categorized as class H per EN 957-1. And as such this equipment is only intended for Home use. It is not intended for commercial, institutional and/or studio facilities use. Contact LIFE FITNESS with any questions regarding this classification.

It is recommended that all users of LIFE FITNESS exercise equipment be informed of the following information prior to use.

ACCESS CONTROL

LIFE FITNESS recommends that all fitness equipment be used in a supervised area. It is recommended that the equipment be located in an access controlled area. Control is the responsibility of the facility owner.

INSTALLATION

SECURING EQUIPMENT - LIFE FITNESS recommends that all equipment be secured to a solid, level sur face to stabilize and eliminate rocking or tipping over. This must be per formed by a licensed contractor.

PROPER USAGE

1. Do not use any equipment in any way other than as designed or intended by the manufacturer. It is imperative that LIFE FITNESS equipment is used properly to avoid injury.
2. Injuries may result if exercising improperly or excessively. It is recommended that all individuals consult a physician prior to commencing an exercise program. If at any time during exercise you feel faint, dizzy or experience pain, STOP EXERCIZING and consult your physician.
3. Keep body parts (hands, feet, hair, etc.), clothing and jewelry away from moving parts to avoid injury.
4. When adjusting any seat, knee hold down pad, range of motion limiter, foothold pad, pulley or any other type of adjuster, make certain that the adjusting pin is fully engaged in the hole to avoid injury.

INSPECTION

1. DO NOT use or permit use of any equipment that is damaged and or has worn or broken parts. For all LIFE FITNESS equipment use only replacement parts supplied by LIFE FITNESS.
2. Cables and Belts pose an extreme liability if used when frayed. Always replace any cable at first sign of wear (consult LIFE FITNESS if uncertain).
3. Routinely inspect all accessory clips that join attachments to the cables and replace at the first sign of wear.
4. MAINTAIN LABELS AND NAMEPLATES - Do not remove labels for any reason. They contain important information. If unreadable or missing, contact LIFE FITNESS for a replacement.
5. EQUIPMENT MAINTENANCE - Preventative maintenance is the key to smooth operating equipment as well as keeping your liability to a minimum. Equipment needs to be inspected at regular intervals.
6. Ensure that any person(s) making adjustments or performing maintenance or repair of any kind is qualified to do so. LIFE FITNESS will provide service and maintenance training at our corporate facility upon request or in the field if proper arrangements are made.
7. Before any use, examine all accessories approved for use with the LIFE FITNESS equipment for damage or wear.
8. DO NOT ATTEMPT TO USE OR REPAIR ANY ACCESSORY APPROVED FOR USE WITH THE LIFE FITNESS EQUIPMENT WHICH APPEARS TO BE DAMAGED OR WORN.

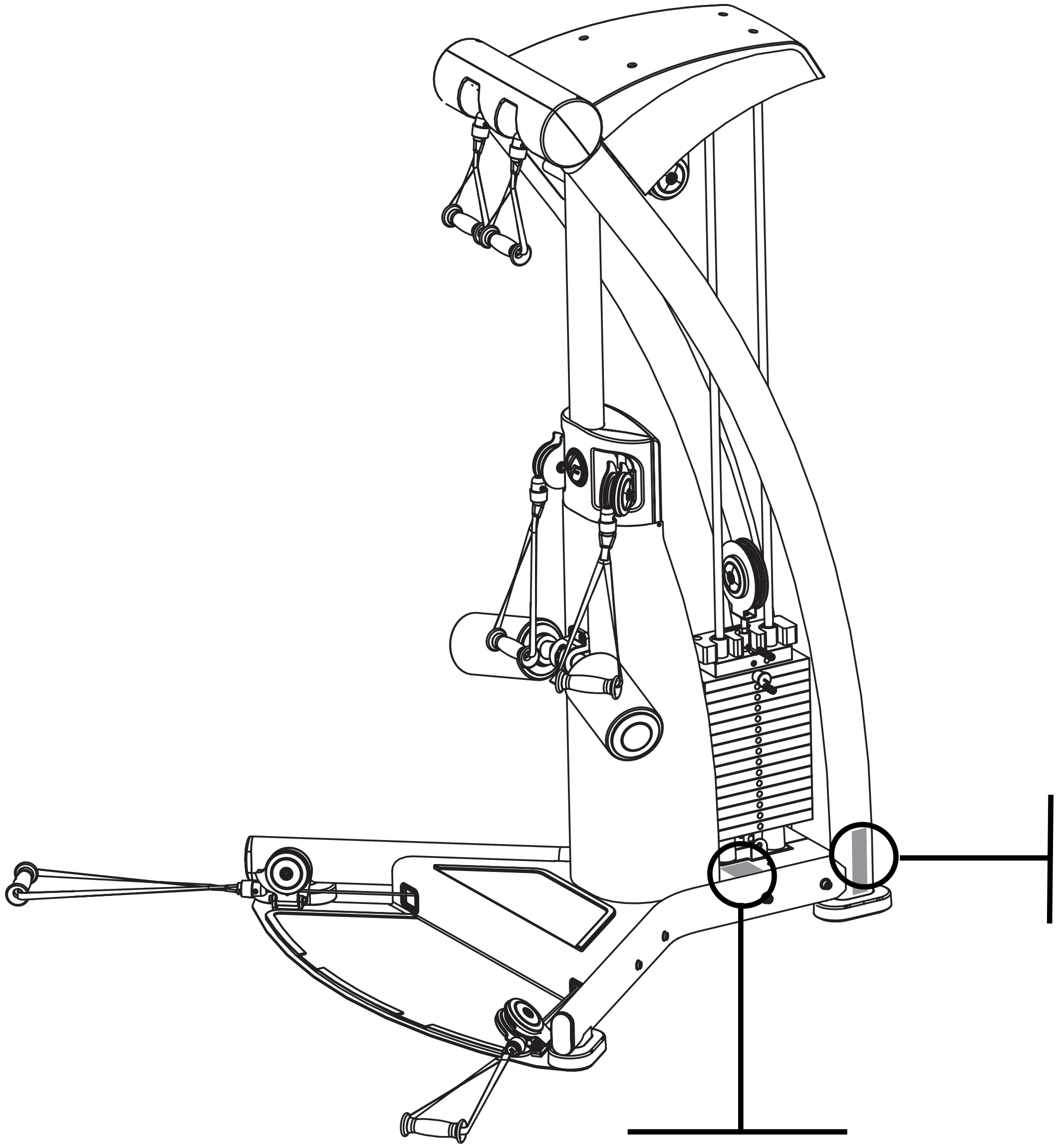
OPERATING WARNINGS

1. It is the purchaser's sole responsibility to properly instruct its end users and supervising personnel as to the proper operating procedures of all LIFE FITNESS equipment.
2. Keep children away from strength equipment. Parent or others supervising children must provide close supervision of children if the equipment is used in the presence of children.
3. Do not allow users to wear loose fitting clothing or jewelry while using equipment. It is also recommended to have user's secure long hair back and up to avoid contact with moving parts.
4. All bystanders must stay clear of all users, moving parts and attached accessories and components while machine is in operation.

SELECTORIZED WEIGHT STACK SYSTEMS

1. Use only weight selector pins supplied by LIFE FITNESS on weight stacks. Substitutes are forbidden.
2. Fully insert weight selector pins. Partial insertion can cause weights to fall unexpectedly.
3. Never pin the weight stack in an elevated position.
4. Never remove selector pin if any weights are suspended.
5. Never attempt to release jammed weights or parts.
6. Never use dumbbells or other means to incrementally increase the weight resistance. Use only those means provided by LIFE FITNESS.

G5 WARNING LABELS

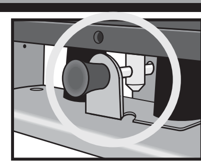


⚠WARNING

SERIOUS INJURY CAN OCCUR ON THIS EQUIPMENT. YOU MUST FOLLOW THESE PRECAUTIONS TO AVOID INJURY!

1. Before using, read all the warnings and obtain instruction on the use of this machine. Use only for intended exercise. **DO NOT** modify the machine.
2. Obtain a medical exam before beginning any exercise program.
3. Keep body, hair and clothing free of all moving objects.
4. Inspect the machines before use. **DO NOT** use if it appears damaged. **DO NOT** attempt to fix a broken or jammed machine. Notify staff immediately.
5. Be certain that weight pin is completely inserted. Use only the pin provided by the manufacturer. If unsure, seek assistance.
6. Never pin the weights or prop plate into an elevated position. **DO NOT** use the machine if found in this condition. **DO NOT** attempt to fix. Seek assistance.
7. Inspect cables and their connections before using machine. **DO NOT** attempt to fix. Seek assistance.
8. Use only the incremental weights supplied by the manufacturer. **DO NOT** use dumbbells or other means to add resistance to the machine.
9. Children must not be allowed near this machine. Supervise teenagers.
10. Manufacturer recommends that all equipment be secured to the floor to stabilize and eliminate rocking or tipping over. Use a licensed contractor.
11. **DO NOT REMOVE THIS LABEL. REPLACE IF DAMAGED.**

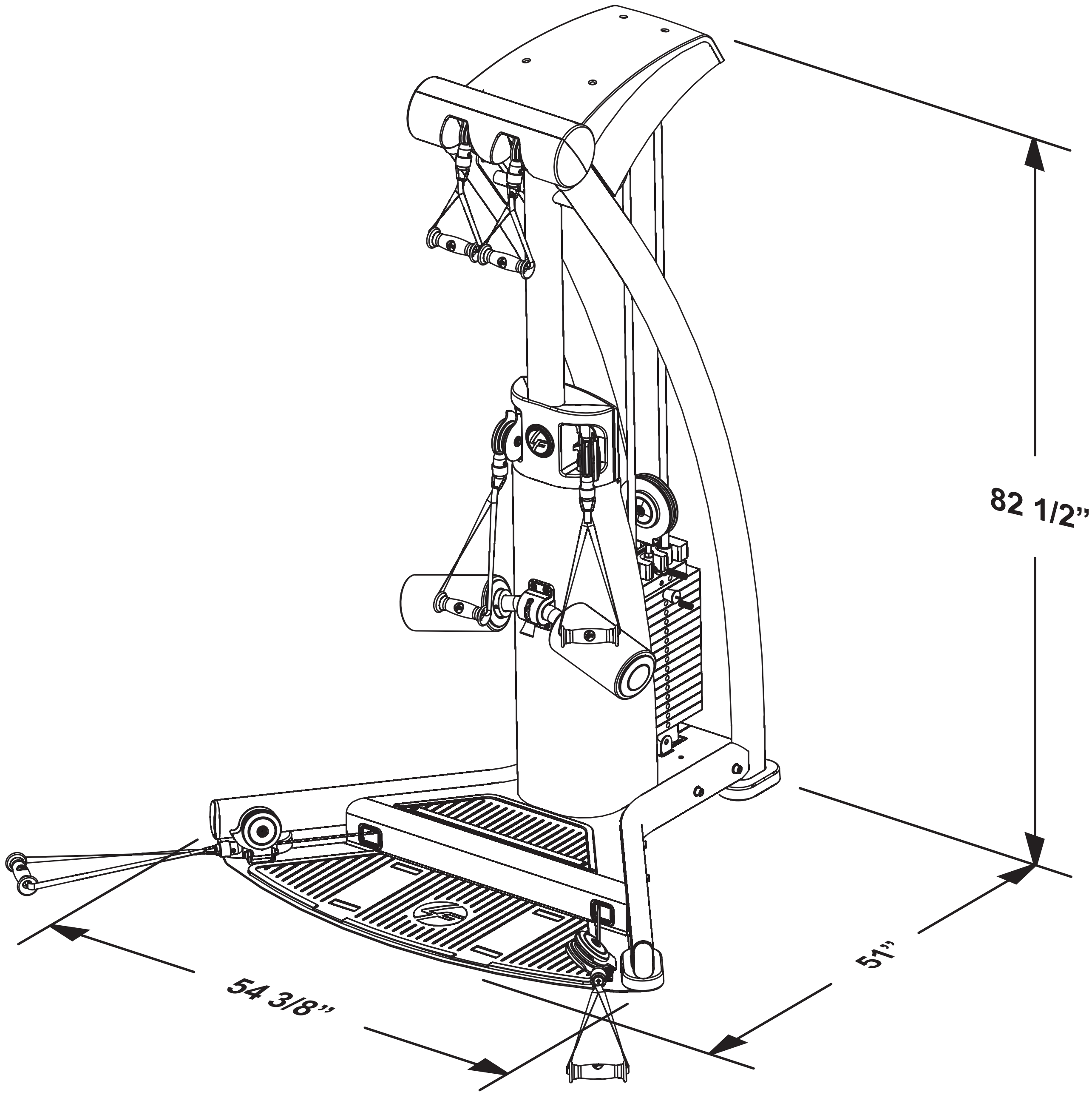
⚠ WARNING



Lock weight stack when machine is not in use.

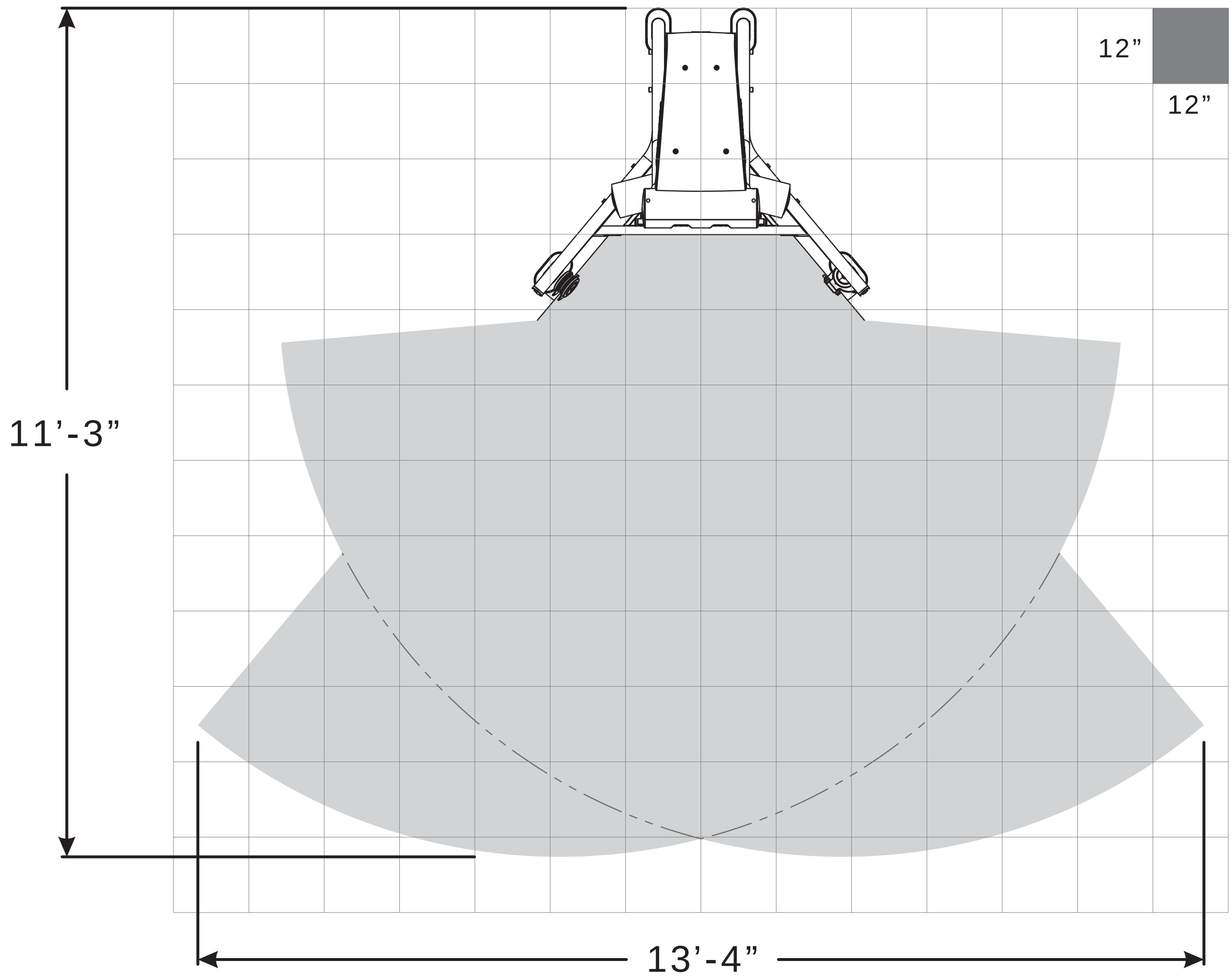
NOTE: Lock the weight stack when not using the gym. Make sure all the weight plates are resting on the plate below with no gap in between. Insert the weight selector pin in the tab underneath the weight stack. The weight selector pin should be inserted until the knob touches the metal tab. Once the pin goes through the weight stack system, the weight stack becomes immobile. Verify that the pin has gone through the weight stack stem.

GYM DIMENSIONS



Resistance Ratio: 1:2
Machine Weight: 500 pounds
Weight Stack: 160 pounds

G5 LIVE AREA



NOTE: The live area shows the extent of the G5 gym. It does not include the user.

COMPONENTS LIST

NOTE: This component list is for ASSEMBLY ONLY. For ordering serviceable parts, please go to:
http://us.home.lifefitness.com/content.cfm/servicedocuments

ITEM NO.	QTY.	DESCRIPTION
1	1	FRONT UPRIGHT
2	1	UPPER SWIVEL PULLEYS
3	1	LEFT UPRIGHT
4	1	RIGHT UPRIGHT
5	1	LEFT BASE
6	1	RIGHT BASE
7	1	FOOT PLATE
8	2	GUIDE ROD
9	15	WEIGHT PLATE
10	1	HEAD PLATE PULLEY
11	1	SELECTOR PIN
12	1	TOP PLATE
13	2	WEIGHT STACK CUSHION
14	2	FLOATING PULLEYS
15	1	FRONT SHROUD
16	1	RIGHT BOTTOM PLATE
17	1	LEFT BOTTOM PLATE
18	1	BACK THIGH HOLD CLAMP
19	1	THIGH HOLD DOWN
20	1	TOP BACK COVER
21	1	TOP FRONT COVER
22	1	MOUNTING SHEET
23	1	TOP COVER
24	1	TOP RIGHT COVER
25	1	TOP LEFT COVER
26	2	SHORT HANDLE
27	2	MEDIUM HANDLE
28	2	ADJUSTABLE HANDLE
29	1	UPPER (LONG) CABLE
30	2	LOWER (SHORT) CABLE
31	2	GUIDE CABLE
32	6	QUICK CONNECT
33	1	FOOT STRAP
34	1	THIGH STRAP
35	1	ADAPTER BAR
36	2	SNAP LINKS
37	2	UNIVERSAL RINGS
38	1	EXERCISE BALL

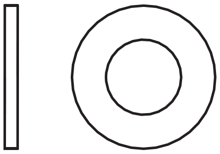
COMPONENTS LIST

HARDWARE		
ITEM NO.	QTY.	DESCRIPTION
39	14	3/8" WASHER
40	4	M10 X 30MM SCREW
41	8	M10 X 70MM SCREW
42	4	M12 X 80MM SCREW
43	8	1/2" WASHER
44	4	M12 HEX NYLOCK NUT
45	2	M10 X 50 HEX TENSION SCREW
46	2	GUIDE ROD RETAINER
47	4	M4 X 0.7MM ZINC PHILLIPS PAN HEAD SCREW
48	2	M10 X 20MM SCREW
49	2	RETAINING RING
50	4	#10-32 X 3/4" PHILLIPS PAN HEAD SCREW
51	2	M6 X 60MM SCREW
52	2	1/4" WASHER
53	4	M10 HEX NYLOCK NUT
54	8	M4 ZINC PHILLIPS PAN HEAD SCREW
55	2	#6 X 3/8" BLACK PHILLIPS PAN HEAD SCREW

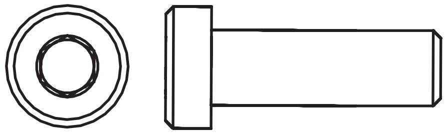
REQUIRED TOOLS

- ADJUSTABLE WRENCH
- EXTERNAL SNAP RING PLIERS
- PHILLIPS SCREW DRIVER
- ALLEN WRENCHES (4mm, 7mm, 8mm)
- WRENCHES (13mm, 17mm, 19mm)

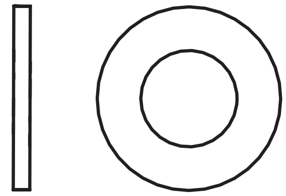
HARDWARE:



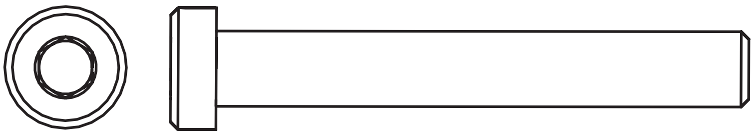
3/8" WASHER (#39)



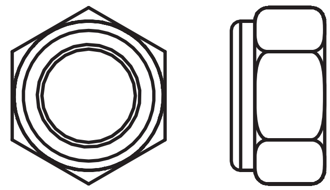
M10 X 30MM SCREW (#40)



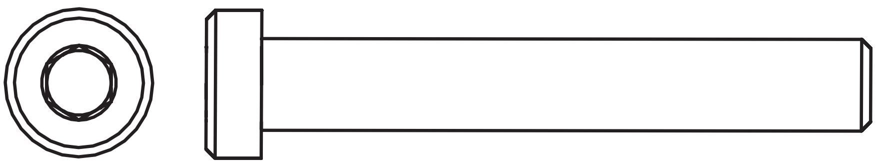
1/2" WASHER (#43)



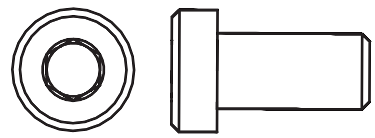
M10 X 70MM SCREW (#41)



M12 HEX NYLOCK NUT (#44)

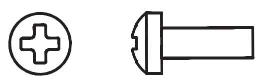


M12 X 80MM SCREW (#42)

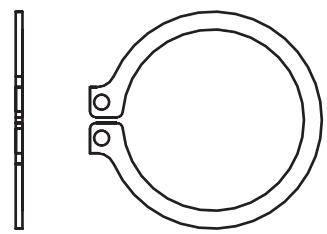


M10 X 20MM SCREW (#48)

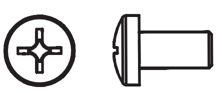
M10 X 50MM HEX TENSION SCREW (#45)



M4 X 0.7mm ZINC
PHILLIPS PAN HEAD
SCREW (#47)

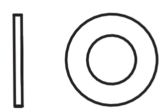


RETAINING RING (#49)

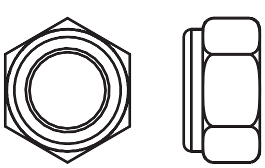


#10-32 X 3/4"
PHILLIPS PAN HEAD
SCREW (#50)

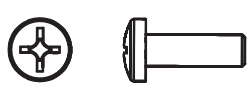
M6 X 60MM SCREW (#51)



1/4" WASHER (#52)

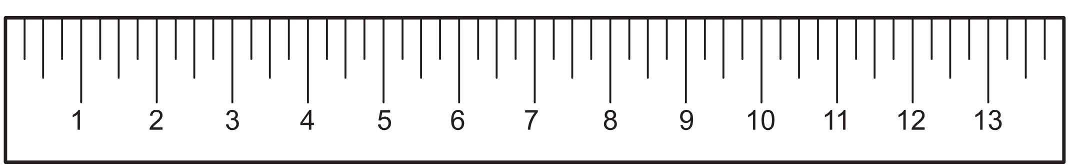


M10 HEX
NYLOCK NUT (#53)

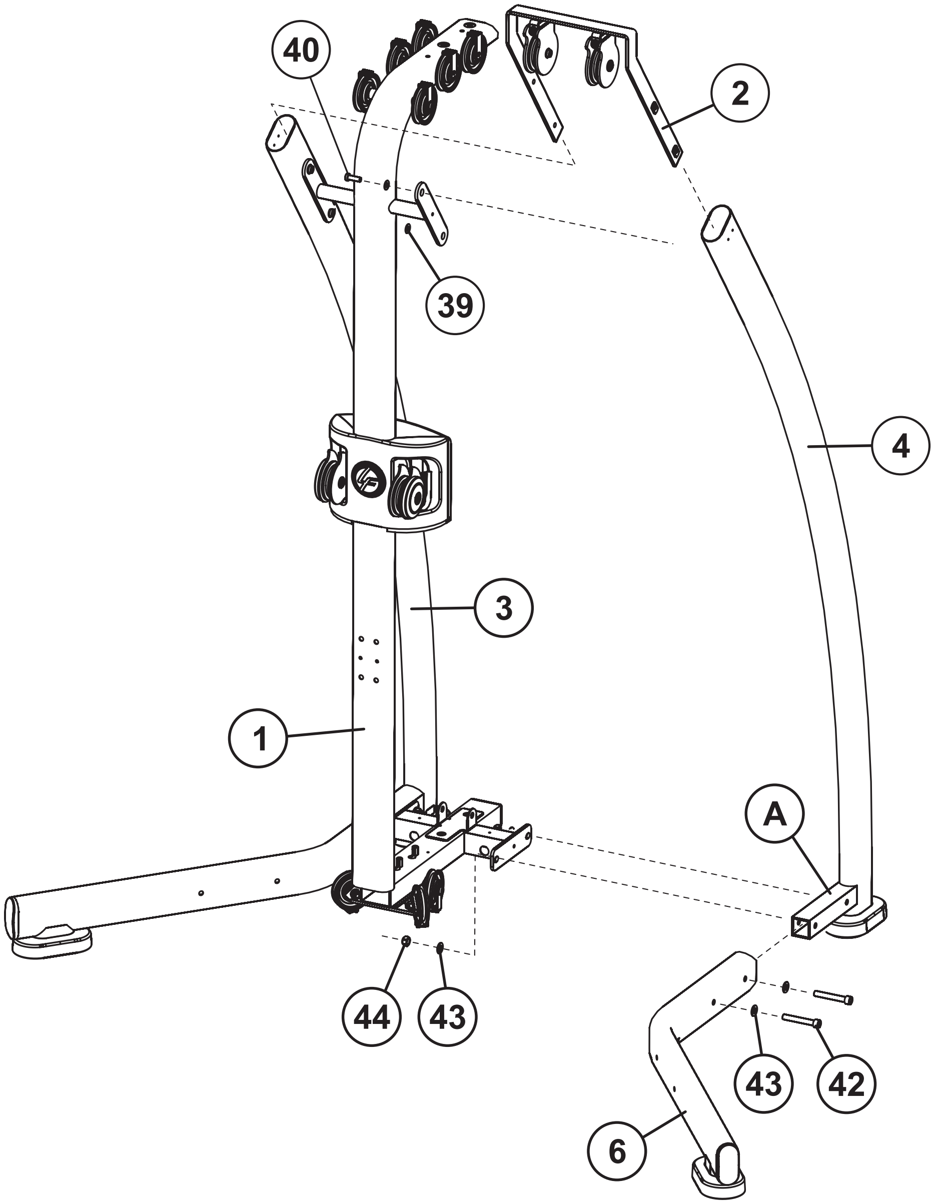


M4 ZINC
PHILLIPS PAN HEAD
SCREW (#54)

#6 X 3/8" BLACK
PHILLIPS PAN HEAD
SCREW (#55)



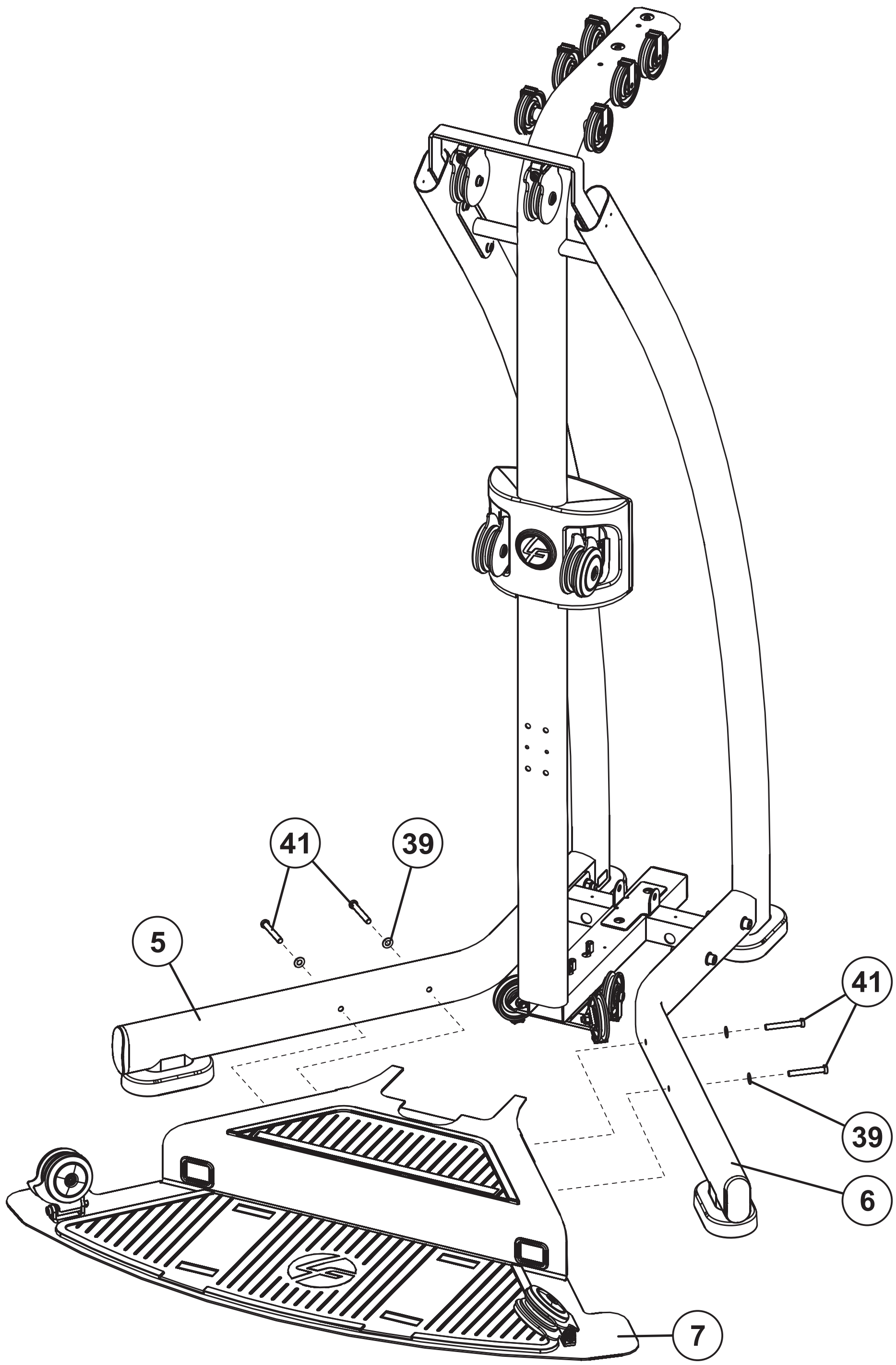
Centimeters



STEP 1:

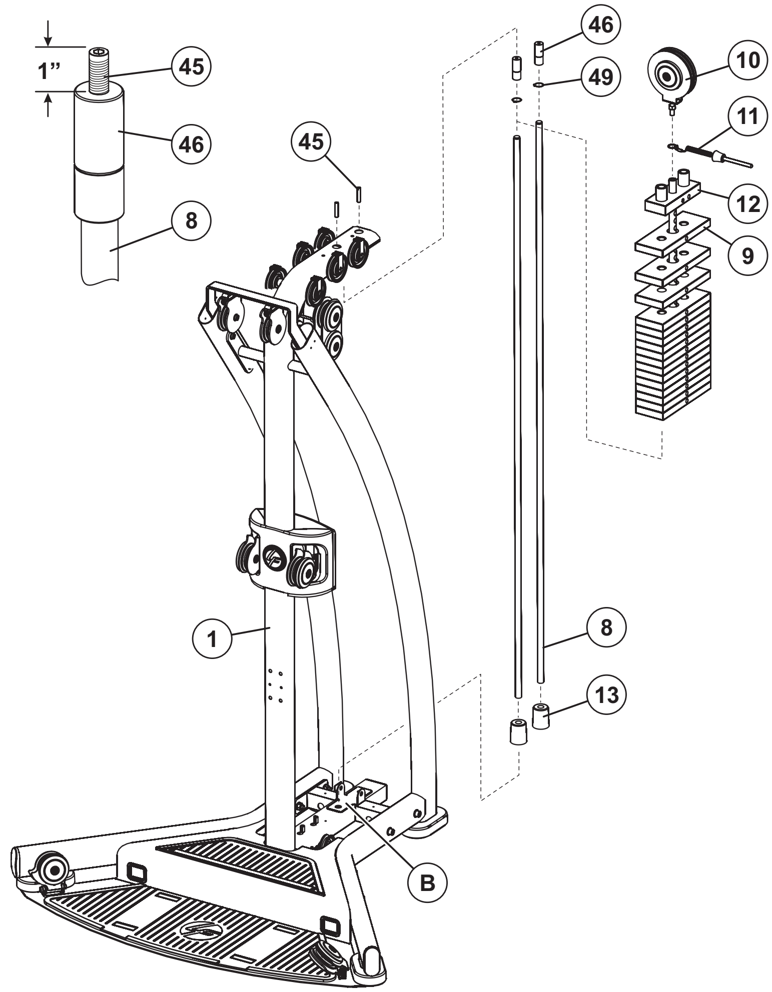
- ❑ Slide the RIGHT BASE (6) over the MOUNTING TUBE (A) of the RIGHT UPRIGHT (4). Loosely secure the RIGHT BASE (6) and RIGHT UPRIGHT (4) to the FRONT UPRIGHT (1) using two M12 x 80mm SCREWS (42), four 1/2" WASHERS (43), and two M12 HEX NYLOCK NUTS (44) as shown.
- ❑ With the UPPER SWIVEL PULLEYS (2) oriented as shown, insert the UPPER SWIVEL PULLEYS (2) into the top of the RIGHT UPRIGHT (4) and secure together the RIGHT UPRIGHT (4), FRONT UPRIGHT (1), and UPPER SWIVEL PULLEYS (2) using two M10 x 30mm SCREWS (40) and two FLAT 3/8" WASHERS (39).
- ❑ Repeat the above steps to assemble the LEFT UPRIGHT (3) and LEFT BASE (5) to the FRONT UPRIGHT (1).

NOTE: THE UPPER SWIVEL PULLEYS (2) ATTACH TO THE INSIDE OF THE UPRIGHT SIDES AND THE ORIENTATION SHOULD BE AS SHOWN.



STEP 2:

- ❑ **LOOSELY** attach the FOOTPLATE (7) to the RIGHT BASE (6) and LEFT BASE (5) using four M10 x 70mm SCREWS (41) and four FLAT 3/8” WASHERS (39).

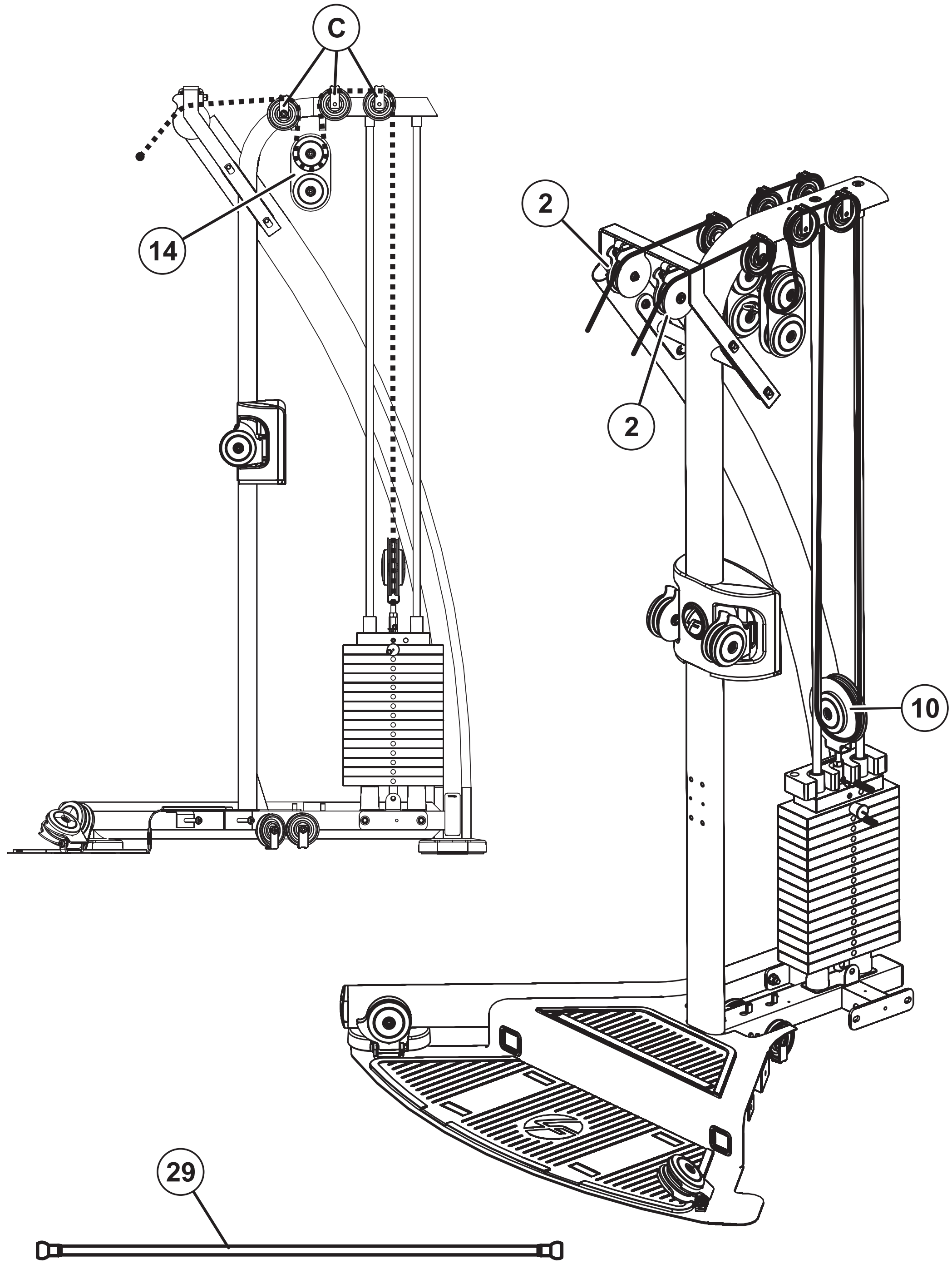


STEP 3:

- ❑ Position two WEIGHT STACK CUSHIONS (13) and GUIDE RODS (8) at the GUIDE ROD BRACKET (B) on the bottom of the FRONT UPRIGHT (1).

NOTE: MAKE SURE THAT THE PLUGGED ENDS OF THE GUIDE RODS (8) ARE FACING UP.

- ❑ **CAREFULLY** slide one of the WEIGHT PLATES (9) over the top of the GUIDE RODS (8) and slowly lower the WEIGHT PLATE (9) on to the WEIGHT STACK CUSHIONS (13).
- ❑ Continue stacking a total of 15 WEIGHT PLATES (9).
- ❑ Slide the TOP PLATE (12) over the GUIDE RODS (8) and slowly lower it onto the WEIGHT PLATES (9).
- ❑ Slide the SELECTOR PIN (11) over the stem of the TOP PLATE (12).
- ❑ Thread the HEAD PLATE PULLEY (10) into the TOP PLATE (12).
- ❑ Slide one RETAINING RING (49) over the top of each of the GUIDE RODS (8).
- ❑ Thread one M10 x 50mm HEX TENSION SCREW (45) into each of the two GUIDE ROD RETAINERS (46). Do not fully thread the M10 x 50mm HEX TENSION SCREWS (45) into the GUIDE ROD RETAINERS (46).
- ❑ **CAREFULLY** slide the GUIDE ROD RETAINERS (46) into the hole under the top of the FRONT UPRIGHT (1). Make sure the M10 x 50mm HEX TENSION SCREWS (45) in the GUIDE ROD RETAINERS (46) are facing up.
- ❑ Push the GUIDE ROD RETAINERS (46) up high enough so that the GUIDE RODS (8) can be placed under them.
- ❑ Lower the GUIDE ROD RETAINERS (46) over the GUIDE RODS (22).
- ❑ Slide the RETAINING RINGS (49) up. Use External Snap Ring Pliers to secure the RETAINING RINGS (49) into the groove on the GUIDE ROD RETAINERS (46).
- ❑ Tighten all frame bolts securely.

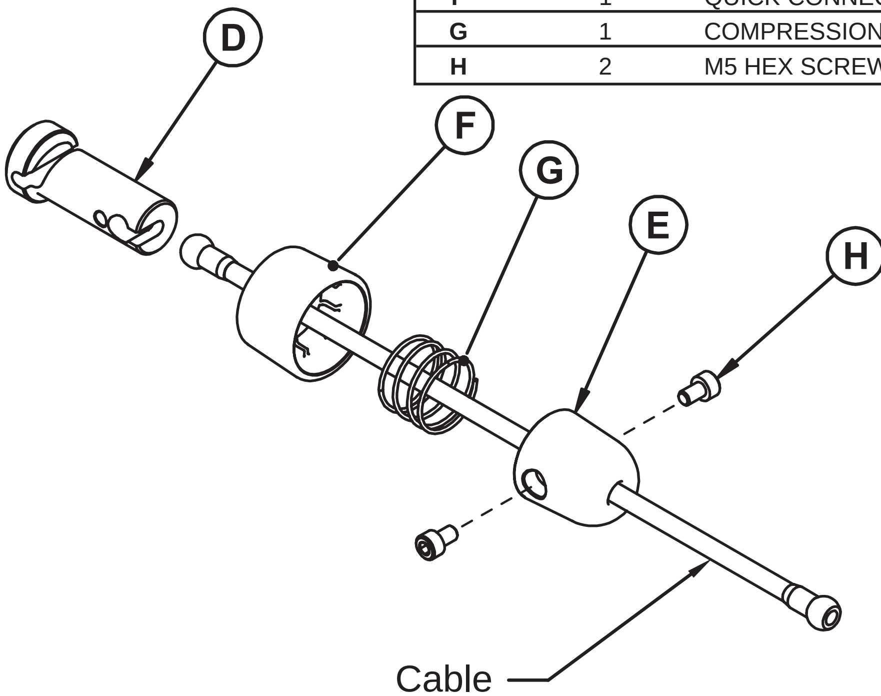


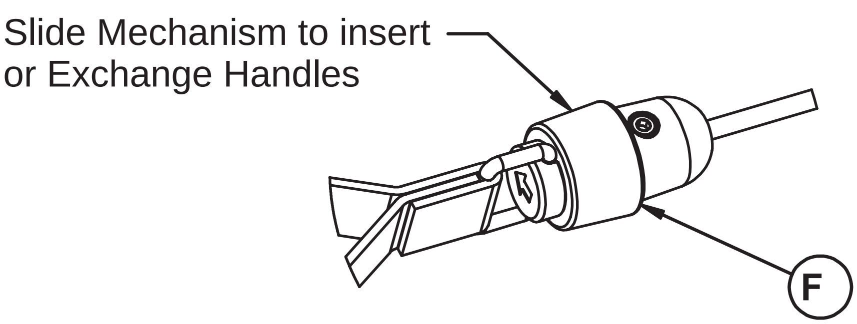
STEP 4:

- ❑ Remove one QUICK CONNECT from the end of one UPPER (LONG) CABLE (29).
- ❑ Insert the end (where the QUICK CONNECT was removed) of the UPPER (LONG) CABLE (29) through the UPPER SWIVEL PULLEYS (2) and follow routing illustration to the FLOATING PULLEYS (14) through to the HEAD PLATE PULLEY (10). Continue to the other side, ending at the other UPPER SWIVEL PULLEYS (2). Reattach the previously removed QUICK CONNECT to the end of the UPPER (LONG) CABLE (29).

NOTE: THE CABLE MUST BE INSERTED BETWEEN THE PULLEY AND THE CABLE RETAINING CLIPS (C) AND MOVE FREELY.

ITEM	QTY.	DESCRIPTION
32	**6**	**QUICK CONNECT ASSEMBLY**
D	1	QUICK CONNECT COUPLER
E	1	QUICK CONNECT HOUSING
F	1	QUICK CONNECT SLEEVE
G	1	COMPRESSION SPRING
H	2	M5 HEX SCREWS

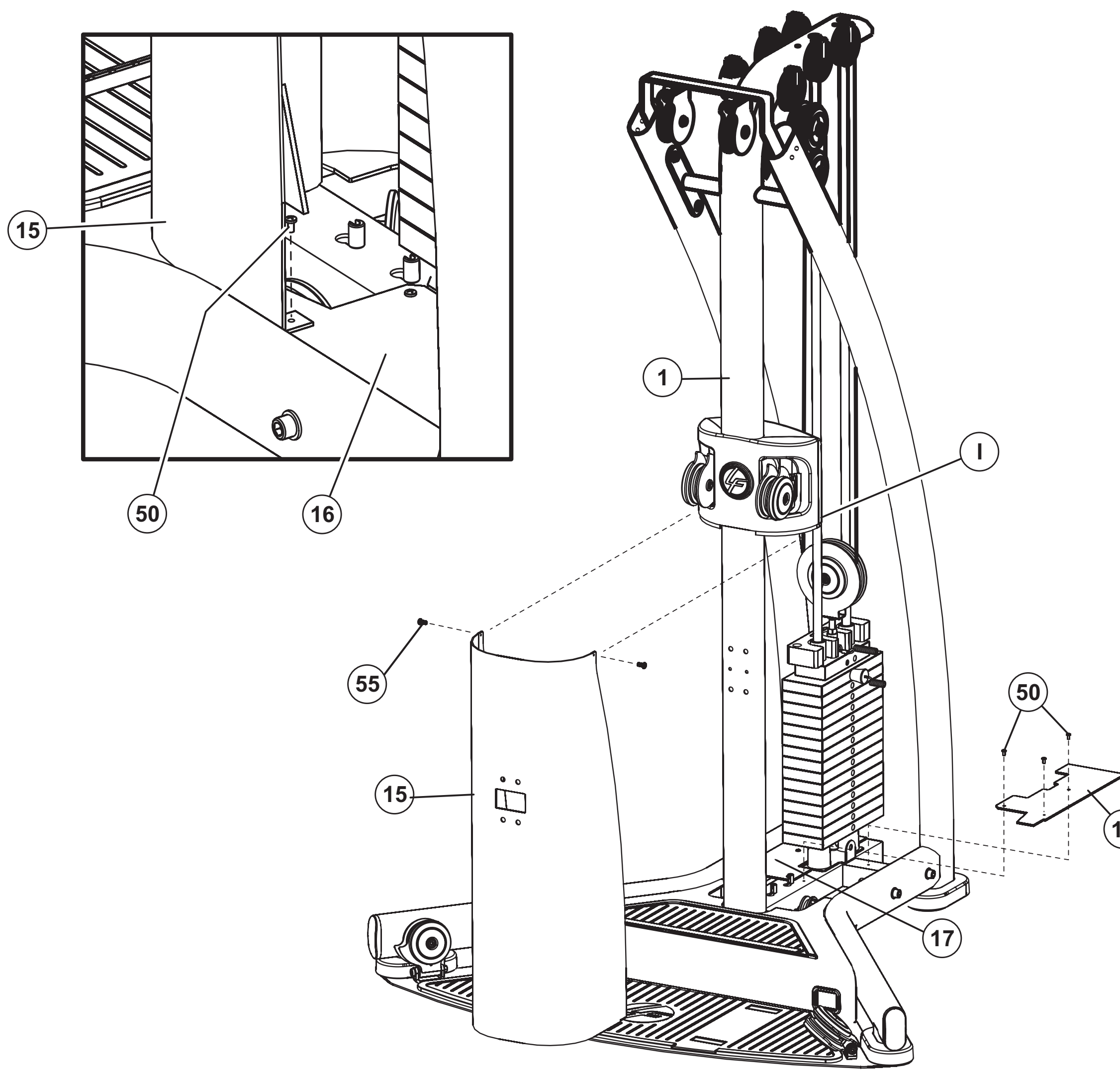




STEP 5:

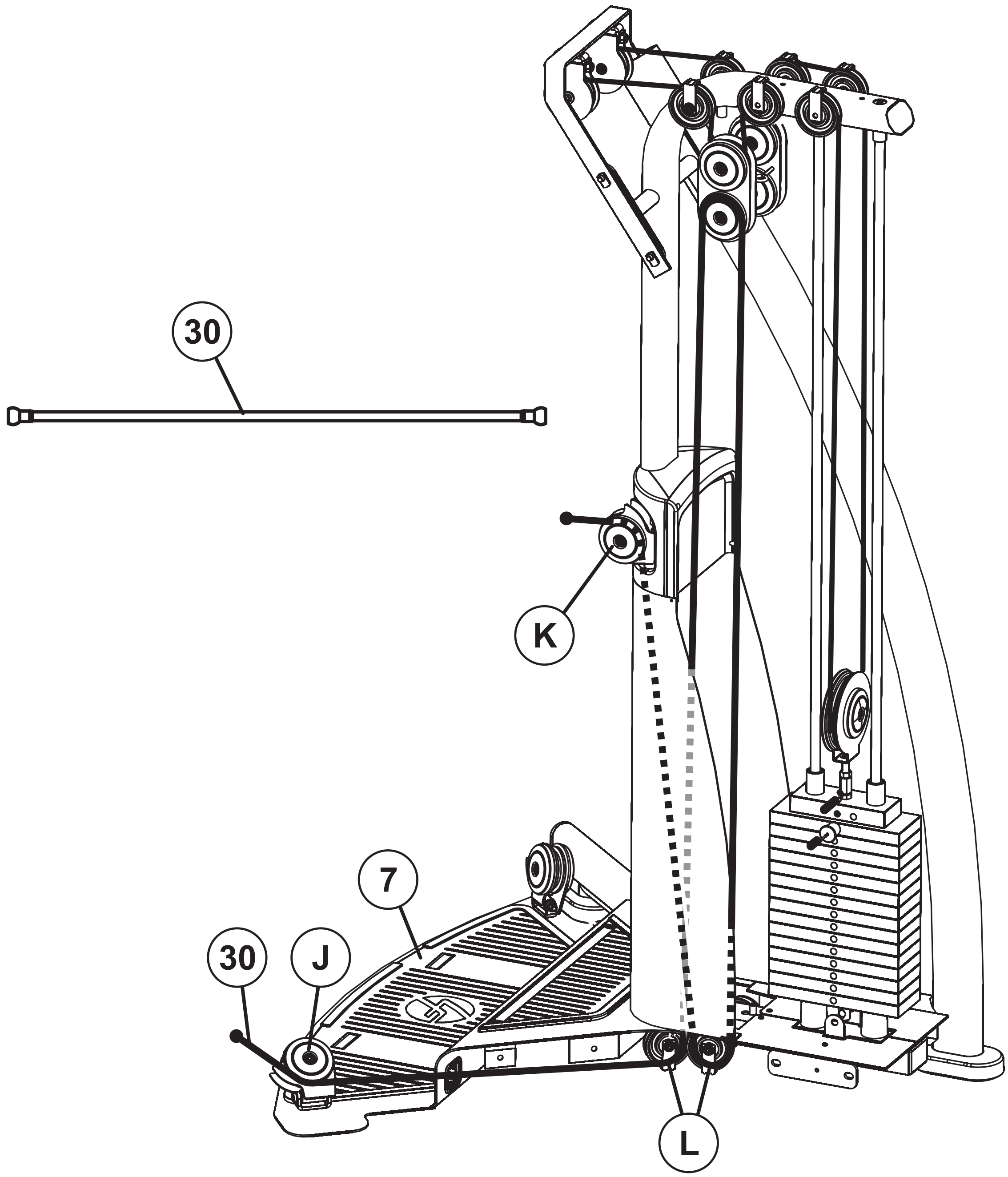
- ❑ Dissemble the QUICK CONNECT (32) by removing the two M5 HEX SCREWS (H) from the QUICK CONNECT COUPLER (D). Carefully remove the COMPRESSION SPRING (G), the QUICK CONNECT SLEEVE (F) and the QUICK CONNECT HOUSING (E).
- ❑ Slide the QUICK CONNECT HOUSING (E), COMPRESSION SPRING (G), and QUICK CONNECT SLEEVE (F) onto the cable as shown. Insert the cable end into the QUICK CONNECT COUPLER (D).
- ❑ Slide the entire assembly over the QUICK CONNECT COUPLER (D). Attach the QUICK CONNECT COUPLER (D) and QUICK CONNECT HOUSING (E) together. Use the two M5 HEX SCREWS (H) to tighten.

NOTE: IF NECESSARY, ENSURE THE CABLES ARE THE PROPER LENGTH AND MAKE NECESSARY ADJUSTMENTS TO THE WEIGHT STACK PULLEY (TIGHTEN OR LOOSEN).



STEP 6:

- ❑ Mount the RIGHT BOTTOM PLATE (16) and the LEFT BOTTOM PLATE (17) to the FRONT UPRIGHT (1) using two 10-32 x 3/4” PHILLIPS PAN HEAD SCREWS (50) for each plate.
- ❑ Place the FRONT SHROUD (15) around the FRONT UPRIGHT (1).
- ❑ Align the bottom mounting holes of the FRONT SHROUD (15) with the remaining mounting holes on the RIGHT BOTTOM PLATE (16) and the LEFT BOTTOM PLATE (17). Secure with one 10-32 x 3/4” PHILLIPS PAN HEAD SCREW (50) on each plate.
- ❑ Attach the bottom corners of the MID BACK COVER (I) to the back of the FRONT SHROUD (15) using two #6 x 3/8” (9.5mm) BLACK PHILLIPS PAN HEAD SCREWS (55). DO NOT OVERTIGHTEN SCREWS INTO PLASTIC PARTS.

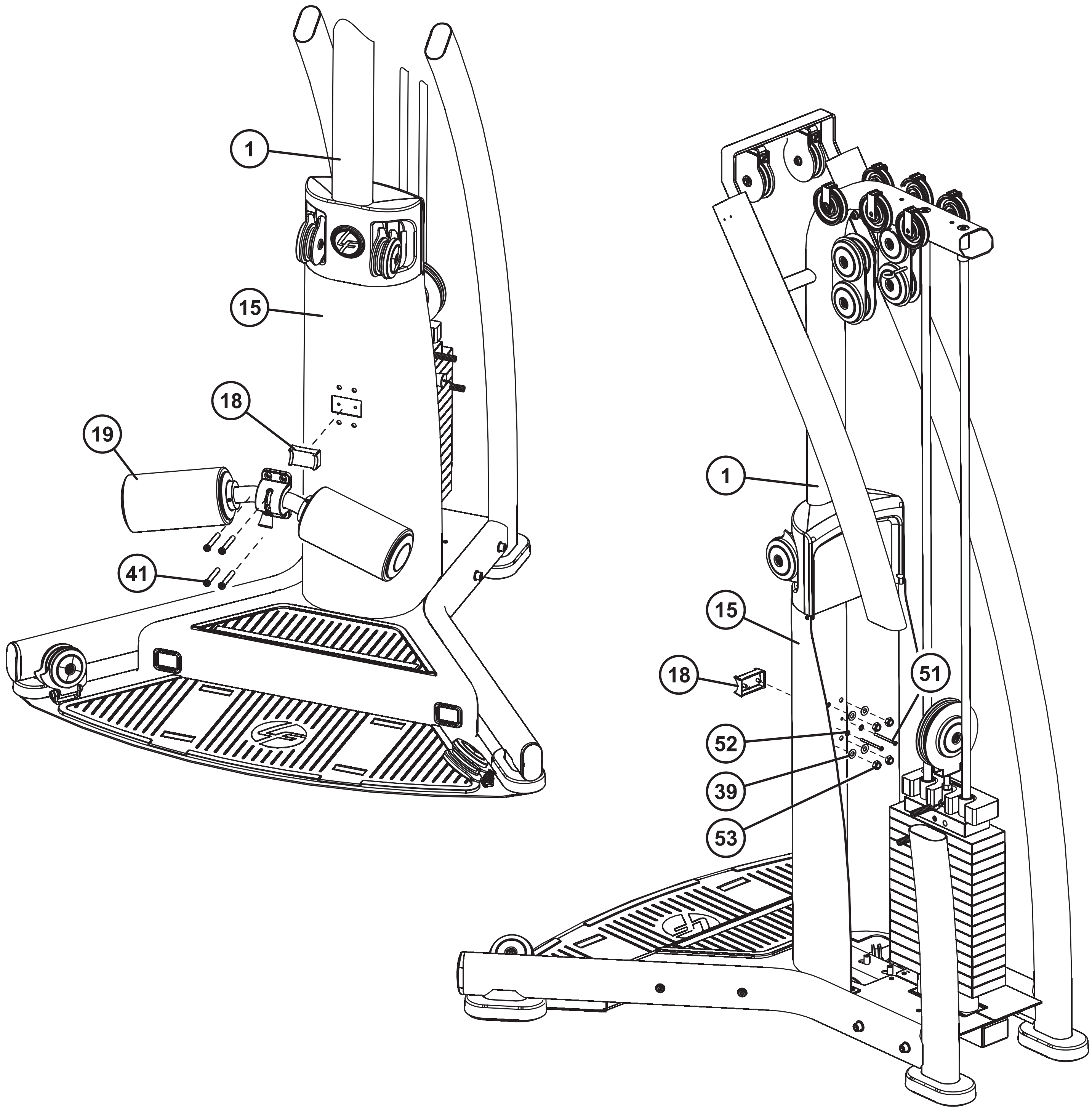


STEP 7:

- ❑ Remove one QUICK CONNECT from the end of one LOWER (SHORT) CABLE (30).
- ❑ Insert the end (where the QUICK CONNECT was removed) of the the LOWER (SHORT) CABLE (30) through the LOWER RIGHT PULLEY (J) and through the access hole in the FOOTPLATE (7). Continue routing the cable as shown ending at the RIGHT MID PULLEY ASSEMBLY (K). Reattach the previously removed QUICK CONNECT to the end of the LOWER (SHORT) CABLE (30).

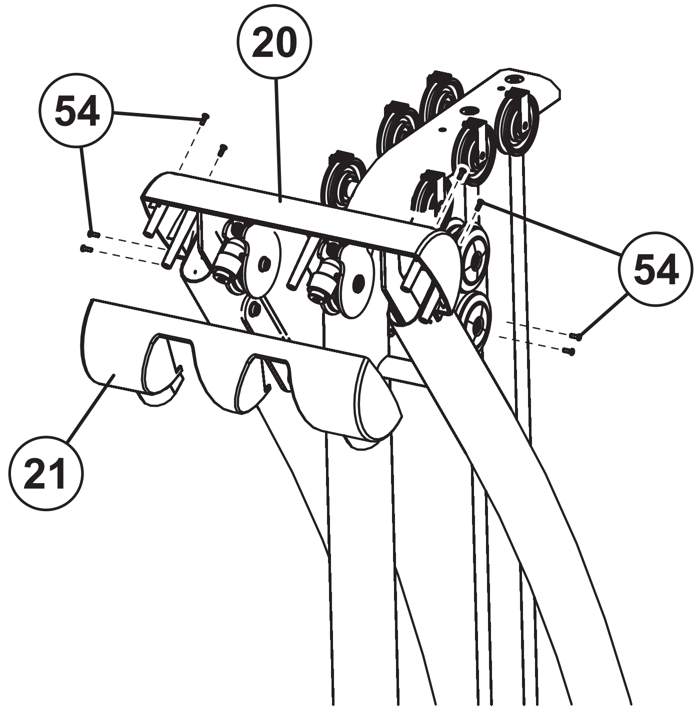
NOTE: THE CABLE MUST BE INSERTED BETWEEN THE PULLEY AND THE PULLEY GUIDE (L) AND MOVE FREELY.

- ❑ Repeat the routing on the left side of the unit using the remaining LOWER (SHORT) CABLE (30).



STEP 8:

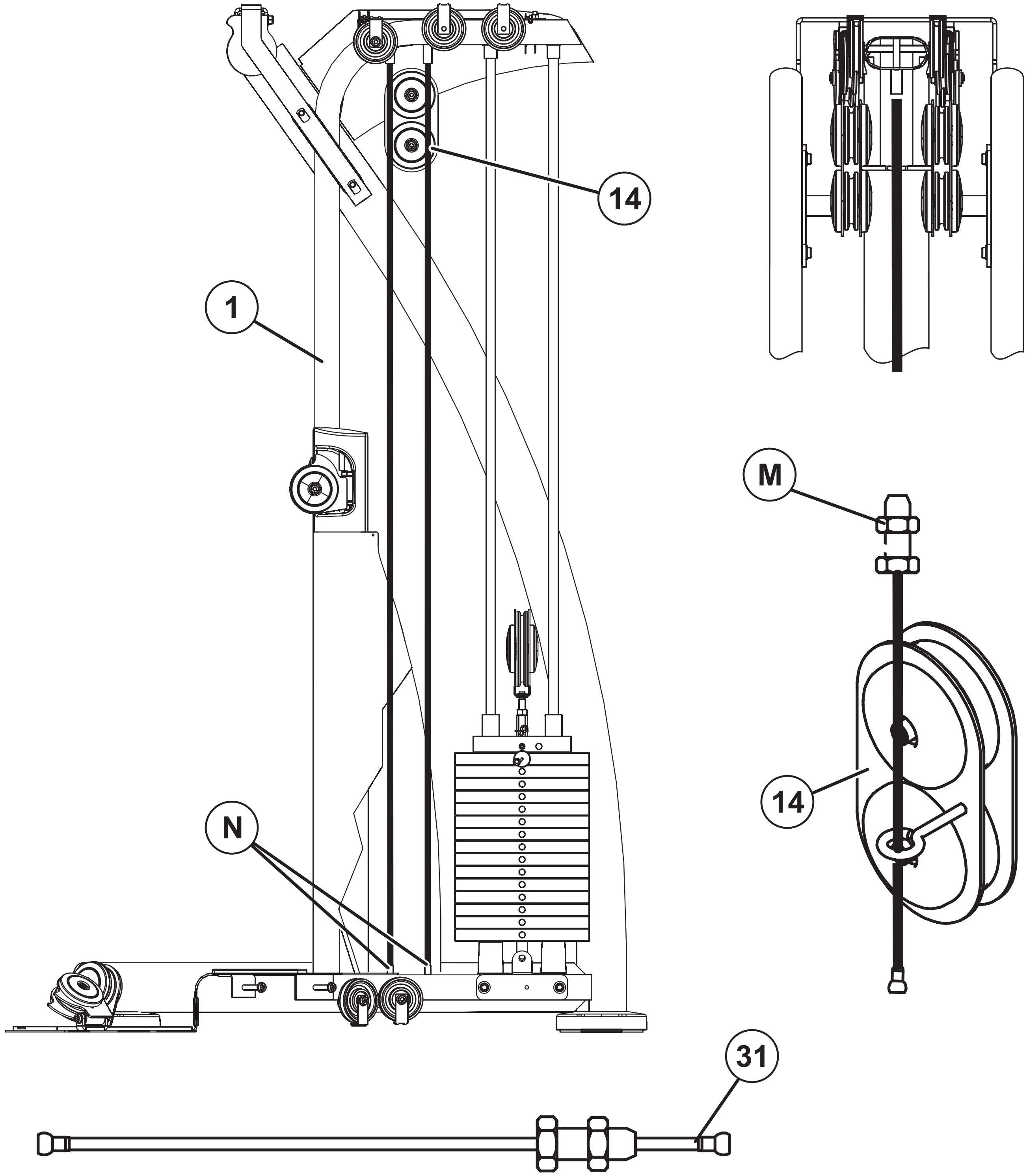
- Attach the BACK THIGH HOLD CLAMP (18) to the the FRONT UPRIGHT (1) by using two M6 x 60mm SCREWS (51) and two 1/4” WASHERS (52) from the back of the FRONT UPRIGHT (1).
- Attach the THIGH HOLD DOWN (19) to the FRONT UPRIGHT (1) by using four M10 x 70mm SCREWS (41), eight 3/8” WASHERS (39), and four M10 HEX NYLOCK NUTS (53) through the FRONT SHROUD (15) and through the FRONT UPRIGHT (1). Tighten SECURELY.



STEP 9:

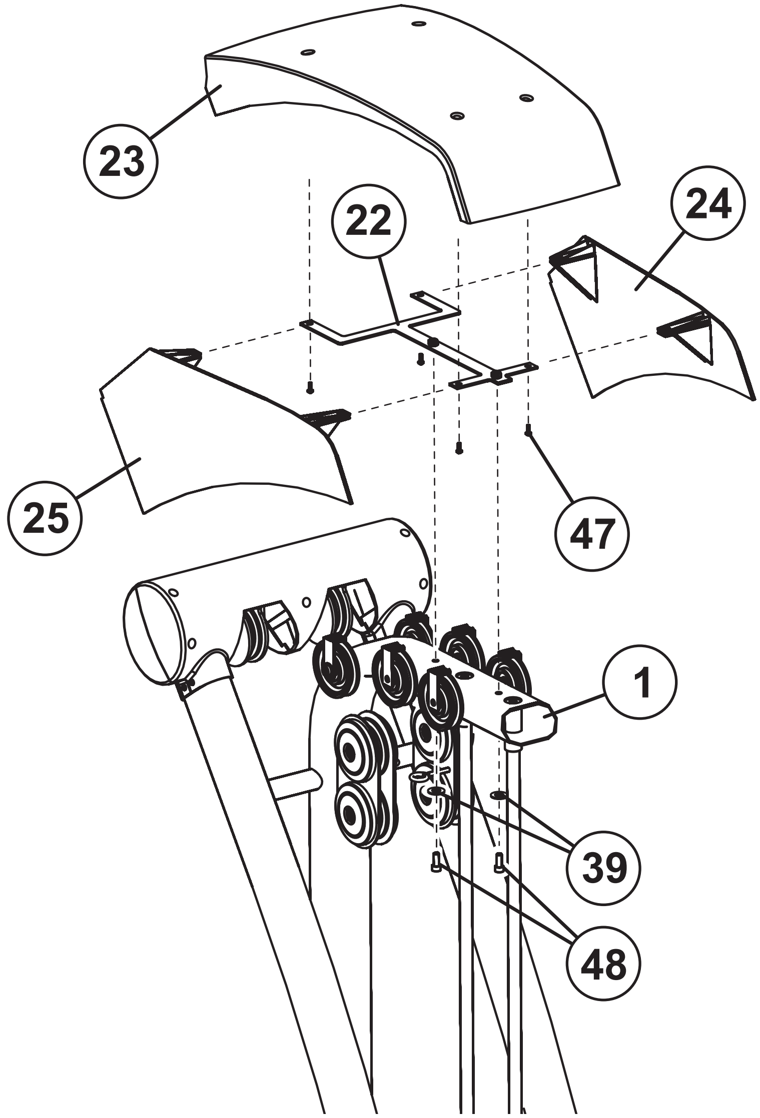
- ❑ Attach the TOP FRONT COVER (21) to the TOP BACK COVER (20) using eight M4 ZINC PHILLIPS PAN HEAD SCREWS (54). DO NOT OVERTIGHTEN SCREWS INTO PLASTIC PARTS.

APPENDIX U



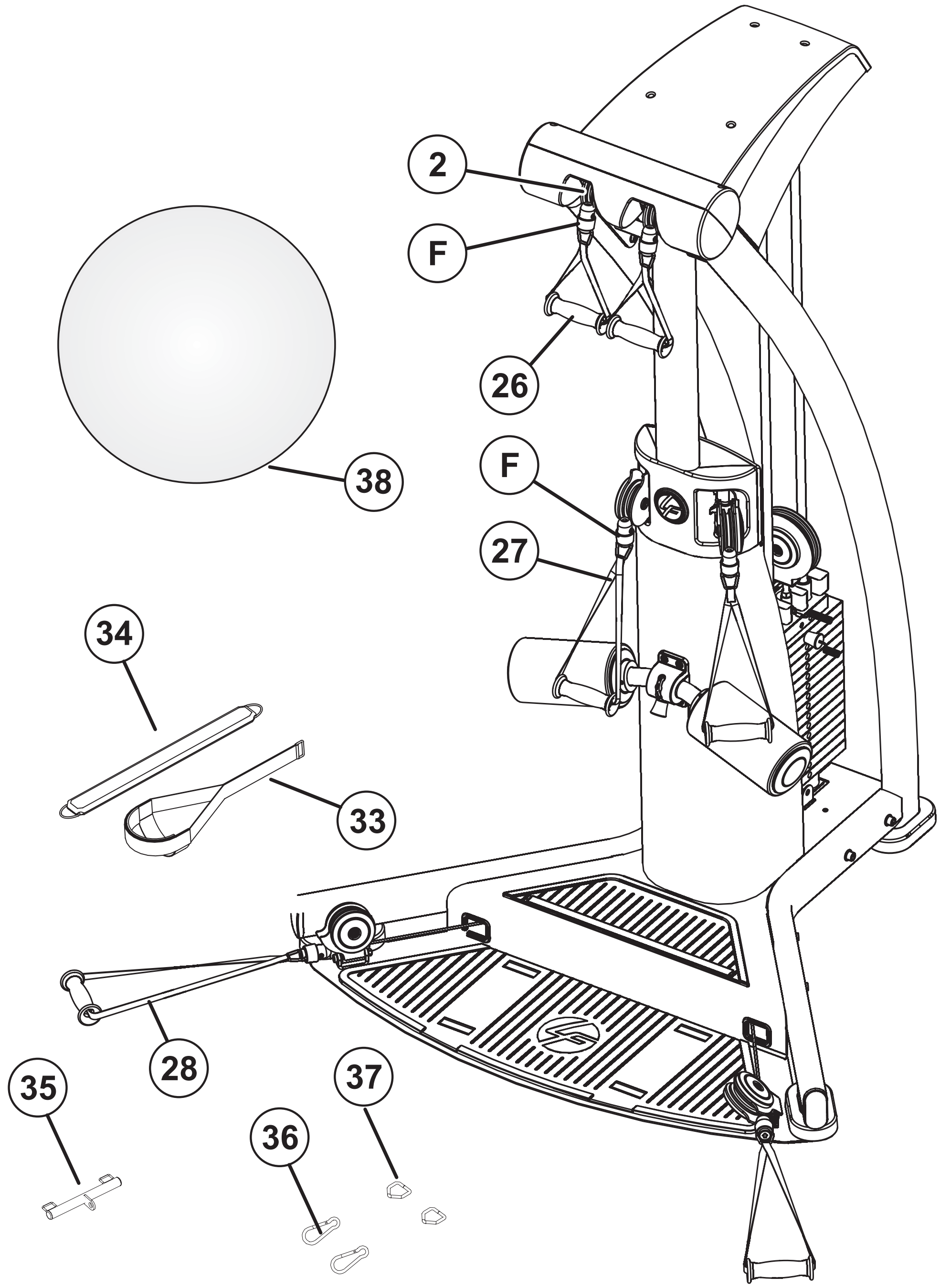
STEP 10:

- ❑ Insert the ball end of one GUIDE CABLE (31) through the eye hook on one FLOATING PULLEYS (14). Insert and hook the ball end of the cable into the SLOTTED BUSHING (N) located at the bottom of the frame located directly below the FLOATING PULLEYS (14).
- ❑ Screw the threaded end of the cable into the FRONT UPRIGHT (1) and loosely tighten the cable by screwing the JAM NUT (M) to the top of the frame.
- ❑ **REPEAT THE ABOVE PROCESS FOR THE REMAINING GUIDE CABLE (31).**



STEP 11:

- ❑ Assemble the MOUNTING SHEET (22) to the top of the FRONT UPRIGHT (1) using two M10 x 20mm SCREWS (48) and two 3/8" WASHERS (39). Tighten screws SECURELY.
- ❑ Attach the TOP LEFT COVER (25), the TOP RIGHT COVER (24) and the TOP COVER (23) to the MOUNTING SHEET (22) using four M4 x 0.7 ZINC PHILLIPS PAN HEAD SCREWS (47). DO NOT OVERTIGHTEN SCREWS INTO PLASTIC PARTS.



STEP 12:

- ❑ Referencing step 5, at the UPPER SWIVEL PULLEYS (2) push back on the QUICK CONNECT SLEEVE (F) at the end of each cable and attach the SHORT HANDLES (26).
- ❑ Repeat the process for attaching the ADJUSTABLE HANDLES (28) to the lower cable ends and the MEDIUM HANDLES (27) to the middle cable ends.

NOTE: THE HANDLE CONFIGURATION DEFINED WILL ACCOMMODATE MOST EXERCISES.

NOTE: THE FOOT STRAP (33) IS TO BE ATTACHED TO ONE OF THE MID SECTION PULLEY CABLE ENDS FOR LEG EXTENSIONS AND TO ONE OF THE LOWER PULLEY CABLE ENDS FOR LEG CURL EXERCISES.

MAINTENANCE

Please note:

* We recommend cleaning your product (pads and frame) on a regular basis, using warm soapy water. Touch-up paint can be purchased from your Life Fitness customer service representative at (800) 351-3737.

* Inspect equipment before each use. Tighten all loose connections and replace worn parts immediately. Failure to do so may result in serious injury.

*** PLEASE RECORD THE INFORMATION REQUESTED BELOW. IN THE EVENT YOU MAY NEED SERVICE YOU WILL BE ASKED FOR THIS INFORMATION. REMEMBER TO FILL OUT YOUR WARRANTY REGISTRATION CARD ON-LINE AT WWW.LIFEFITNESS.COM.**

Model #: ________________________________

Serial #'s: ________________________________

Note: *The Model/Serial Number label is located towards the bottom of the RIGHT UPRIGHT*.

Date of Purchase: ________________________________

Dealer’s Name ________________________________

Dealer’s Phone# ________________________________

Thank you for purchasing the Life Fitness G5 CABLE MOTION GYM SYSTEM

LIMITED WARRANTY

Life Fitness® G5 Cable Motion™ Gym System

Life Fitness extends the following LIMITED WARRANTY to the original owner (proof of purchase required, keep your receipt with this manual) of the Life Fitness product. The Warranty terms apply to IN HOME and LIGHT INSTITUTIONAL USE ONLY.

1. **LIMITED WARRANTY ON FRAME AND WELDS.** If the frame of the Life Fitness product or a weld should crack or break, it will be repaired or replaced by Life Fitness. Terms: IN HOME USE ONLY: Lifetime – for so long as the Customer owns the Life Fitness product; LIGHT INSTITUTIONAL USE: Ten (10) years.
2. **LIMITED WARRANTY ON PARTS.** If the following parts are defective in material or workmanship, Life Fitness will supply replacement parts: all bolts, nuts, washers, bearings, bushings, pulleys, thumbscrews, collars, cable retaining clips, adjustable pre-stretch slides, roller pad shafts, allen head bolts, weight selector pin, weight stack shaft, set screws, protector caps, adjustment chain, cotter pin, plunger, spring and knob. Terms: IN HOME USE ONLY: Lifetime – for so long as the Customer owns the Life Fitness product; LIGHT INSTITUTIONAL USE: One (1) year.
3. **LIMITED WARRANTY ON CABLES AND UPHOLSTERY.** If the coated cables or upholstery are defective in material or workmanship, Life Fitness will repair or replace them, at its option. Terms: IN HOME USE ONLY: Three (3) years; LIGHT INSTITUTIONAL USE: Ninety (90) days.
4. **CONDITIONS AND EXCEPTIONS.** Any product misuse, abuse or alteration, any attempt to repair by a person other than an authorized Life Fitness Service Center, any improper assembly, accident, or any other condition resulting from occurrences beyond the control of Life Fitness will void this Limited Warranty.
5. **REPLACEMENT AND REPAIR EXPENSES.** Life Fitness will provide only replacement parts or repair under this warranty. The Owner is responsible for all other costs. Such costs may include, but are not limited to: a. labor charges for service, removal, repair or reinstallation of the Life Fitness product or any component part; b. shipping, delivery, handling and administrative charges for returning parts to Life Fitness; and c. all necessary or incidental costs related to installation of the replacement parts.
6. **SHIPPING.** If shipping by the Owners is deemed necessary (in sole discretion of Life Fitness), parts should be shipped in their original carton or equivalent packaging, fully insured with shipping charges prepaid. Life Fitness will not assume any responsibility for any loss or damage incurred in shipping.
7. **CLAIM PROCEDURES.** If service on your Life Fitness product is required during the warranty period, please contact our Customer Service Department at 1-800-351-3737 (U.S. and Canada) or +1-847-288-3300 (outside of U.S. and Canada) for instructions regarding returning or replacing parts. Please have available the following information: (i) the dealer's name; (ii) the date of purchase; (iii) the serial # (s) of your product(s) (the serial number location is called out on the final assembly drawing included with your assembly instruction); (iv) a description of the nature of the problem.
8. **OWNER'S RIGHT.** This Limited Warranty gives you specific legal rights. You may also have other rights, which vary depending on local law.
9. **LIMITATION OF IMPLIED WARRANTIES.** All implied warranties, except to the extent prohibited by applicable law, shall have no greater duration than the warranty period set forth above. There are no warranties which extend beyond the description in this Limited Warranty. Because local laws do not allow limitations on how long an implied warranty lasts, the above limitations may not apply to you.
10. **DISCLAIMER.** No other express warranty has been made or will be made on behalf of Life Fitness with respect to any Life Fitness product or the operation, repair or replacement of any Life Fitness product. Life Fitness shall not be responsible for injury, loss of use of the Life Fitness product, inconvenience, loss or damage to personal property, whether direct or indirect, and incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Notes:

Corporate Headquarters

5100 North River Road
Schiller Park, Illinois 60176 • U.S.A.
847.288.3300 • FAX: 847.288.3703
800.735.3867 (Toll-free within U.S.A., Canada)

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Fax: (+31) 180 646 699

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Life Fitness UK LTD

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Fax: (+81) 3.3359.4307

China and Hong Kong
Life Fitness Asia Pacific LTD

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Tsimshatsui, Kowloon
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Fax: (+852) 2575.6001

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Tsimshatsui, Kowloon
HONG KONG
Telephone: (+852) 2891.6677
Fax: (+852) 2575.6001

* Also check **www.lifefitness.com** for local representation or distributor/dealer.

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Blue: KITS

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2. All bearings are to be pressed in with force applied to outer ring only.
3. All hardware to be torqued to specs listed in chart below.
4. Special notes if any are shown below.

F3TT BOM

Number	QTY	DESCRIPTION
01-1258	2	½ -13 UNC x ¾ Bolt
01-1553	2	3/8 -16 UNC x 4½ Bolt
01-3216	2	SHSS ¾" x 1"
01-4030	2	¼ -20 UNC x 1 Wiz Lock Bolt
01-4042	4	BOLT BH ,½ -13 x 1¾" ZINC
01-4051	4	BOLT BH , 3/8 -16 x 1" ZINC
01-4077	4	BOLT BH , ½ -13 x 3" ZINC
01-4081	1	BOLT BH ½ -13 UNC x ¾" ZINC
01-4091	2	BOLT BH 0.375 -16 UNC x 2¾" ZINC
01-4106	9	BOLT BH , ½ -13 X 2 3/4" ZINC
02-4072	4	WHITE SHIELD SCREW ¼-20 x ¾" PHILLIPS
02-4076	8	WHITE SHIELD SCREW ¼-20 x ½" PHILLIPS
03-1035	8	3/8" Lock Nut
03-1055	13	1/2" Lock Nut
03-4030	6	1/4-20 INSERT 1/2" LONG
03-4035	8	1/4-20 INSERT 11/16" LONG
03-4142	6	5/16" Jam Nut
04-2085	2	Washerl 1.0ID x 2 OD x 0.188L
04-5206	4	WASHER, FLAT, 3/8" SAE
04-5207	16	WASHER, FLAT, ½" SAE
04-5209	2	WASHER, FLAT, ¾" SAE
06-4064	2	CABLE PULLEY 3/16" F3TBT LOW PULL
06-4073	1	F3TT WT STACK CABLE 3/16"- 192 3/4"L
06-7080	4	SLOTTED STRAP FORK
07-4805	4	Hand Grip / Ankle Cuff
07-5568	8	PULLEY BUSHING
07-8359	10	IDLER PULLEY SPACER
08-3055	8	IDLER PULLEY SPACER
08-7043	2	SPACER 1 1/4" OD x 1" ID x 1/2"L
09-1009	4	End Cap Angled Flat Oval 2.25 x 4.178

F3TT BOM

Number	QTY	DESCRIPTION
09-1198	1	Cap Nova Tower Top
09-5026	4	FOOTPAD INSERT 3/8" x 2" OD MOLDED BLACK
09-5030	2	FOOTPAD MOLDED BLACK
09-8018	2	GUIDE ROD BUSHING
09-8322	2	Pulley 6 1/2" cable
12-1026	2	KEEP HANDS AWAY
12-1103	1	WEIGHTSTACK 4 3/4 PIN WARNING DECAL Narrow
12-5611	1	Nautilus Transfer Decal - Large BLACK
12-5620	1	NLS Logo 3" Decal
12-6046	1	Made In USA - Seat Frames
12-8003	1	F3TT Instruction Placard
17-1626	2	GUIDE ROD F3TBT 61 3/4" L
19-2552	1	Shield Nova Rear Tall
19-2651	1	SHIELD FRONT LOWER 16 GA F3SSMT
19-2652	1	SHIELD FRONT UPPER STRENGTH TRAINER
45-1037	1	EFSON 3 1/2" PULLEY
45-1042	10	EFSON 4 1/2" PULLEY
45-1051	2	.755 ID BUSHING (IGUS REPLACEMENT)
45-1052	4	.755 ID BUSHING (IGUS REPLACEMENT)
45-1062	2	1.005 ID BUSHING (IGUS REPLACEMENT)
56-0266	4	BALL CABLE RECESSED
56-0438	1	Pulley Bracket 3" F3FT
56-0485	4	Tandem Pulley Plate
56-0553	2	GUARD LOWER BRACE
56-0554	2	SPACER PULLEY GUARD
60-1402	1	Tower HF SPORTS TRAINER
61-1327	2	F3FT BOTTOM RAIL
64-1303	2	UPPER BOOM ASSEMBLY
64-1305	2	LOWER SWIVEL BRACKET
OPT-WT-24	1	WEIGHTSTACK 16 X 10 LB PLATES DUAL F3FT

Bolt Torque Specifications

Size	Grade 5 Torque (ft-lbs)	Grade 8 Torque (ft-lbs)
1/4-20	8	12
1/4-28	10	14
5/16-18	17	25
3/8-16	30	45
7/16-14	50	70
1/2-13	75	110
1/2-20	90	120
5/8-11	150	220
5/8-18	180	240

F3 TOWER TRAINER
F3TT

REV D

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Warranty Field Service Requests: servicerequest@medfitsys com
Med-Fit Systems Inc 800/ 831-7665

www.medfitsystems.com

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APPENDIX V

Red: PAINTED ITEMS
Blue: KITS

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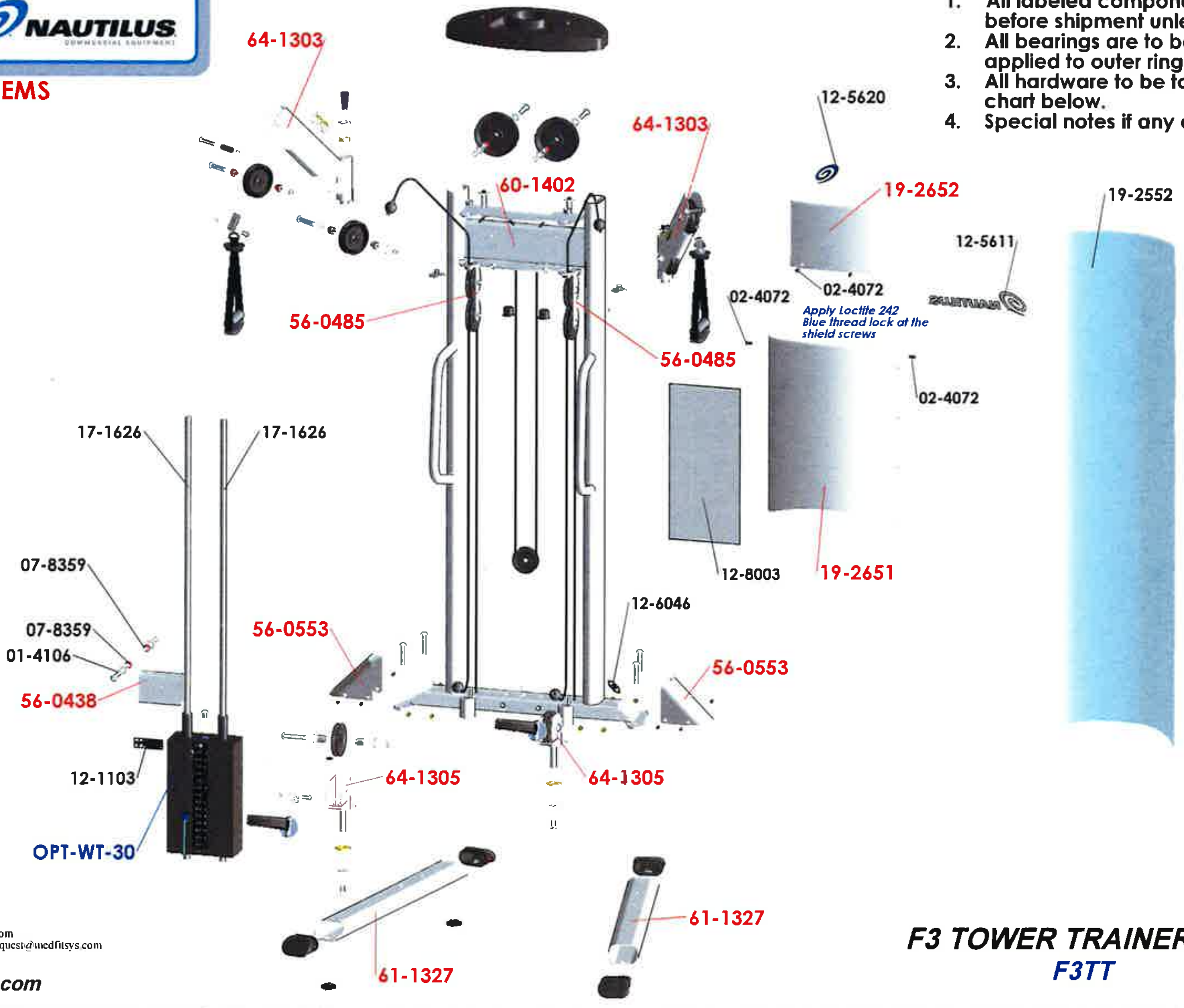
2. All bearings are to be pressed in with force applied to outer ring only.
3. All hardware to be torqued to specs listed in chart below.
4. Special notes if any are shown below.



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F3 TOWER TRAINER
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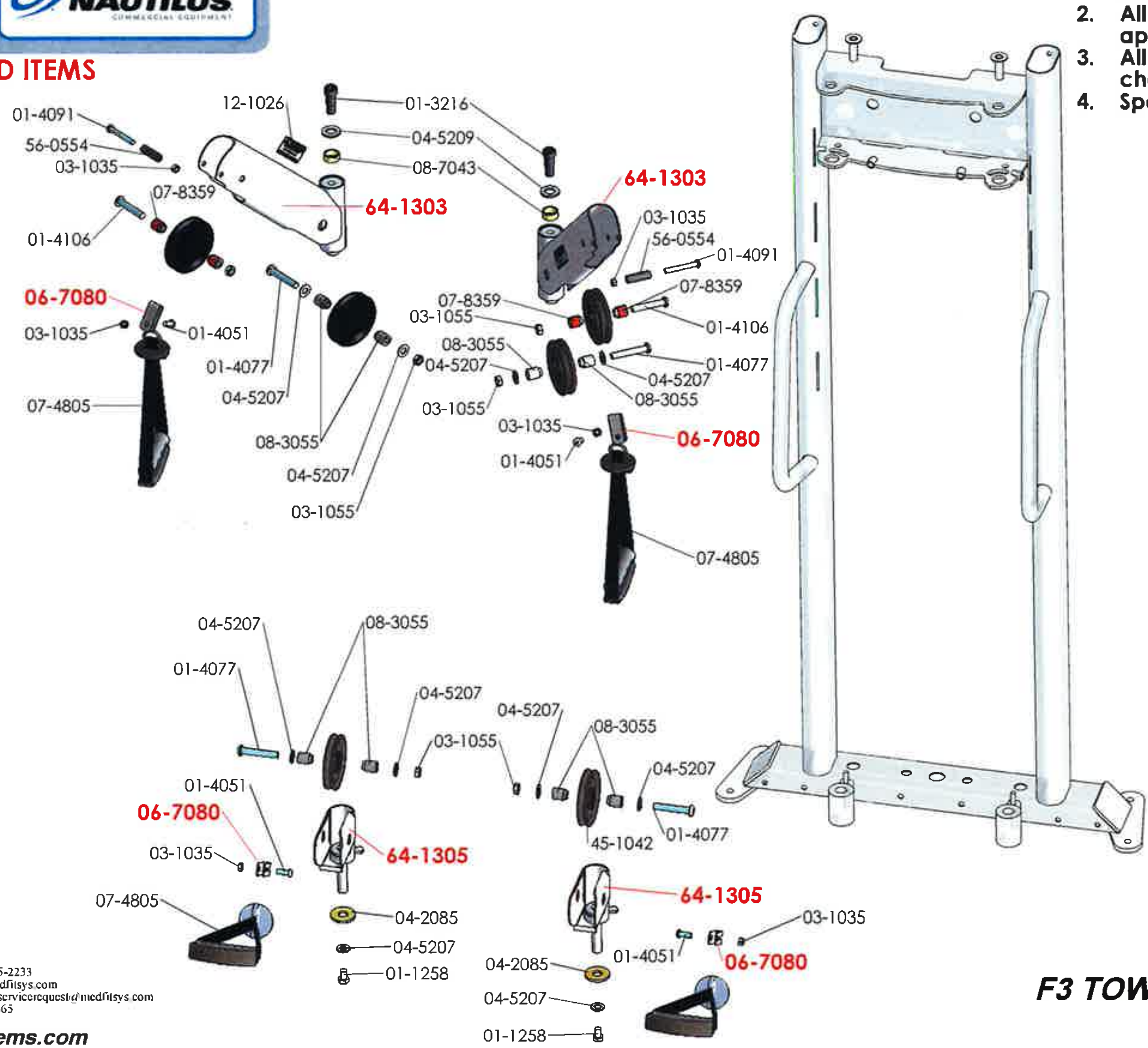

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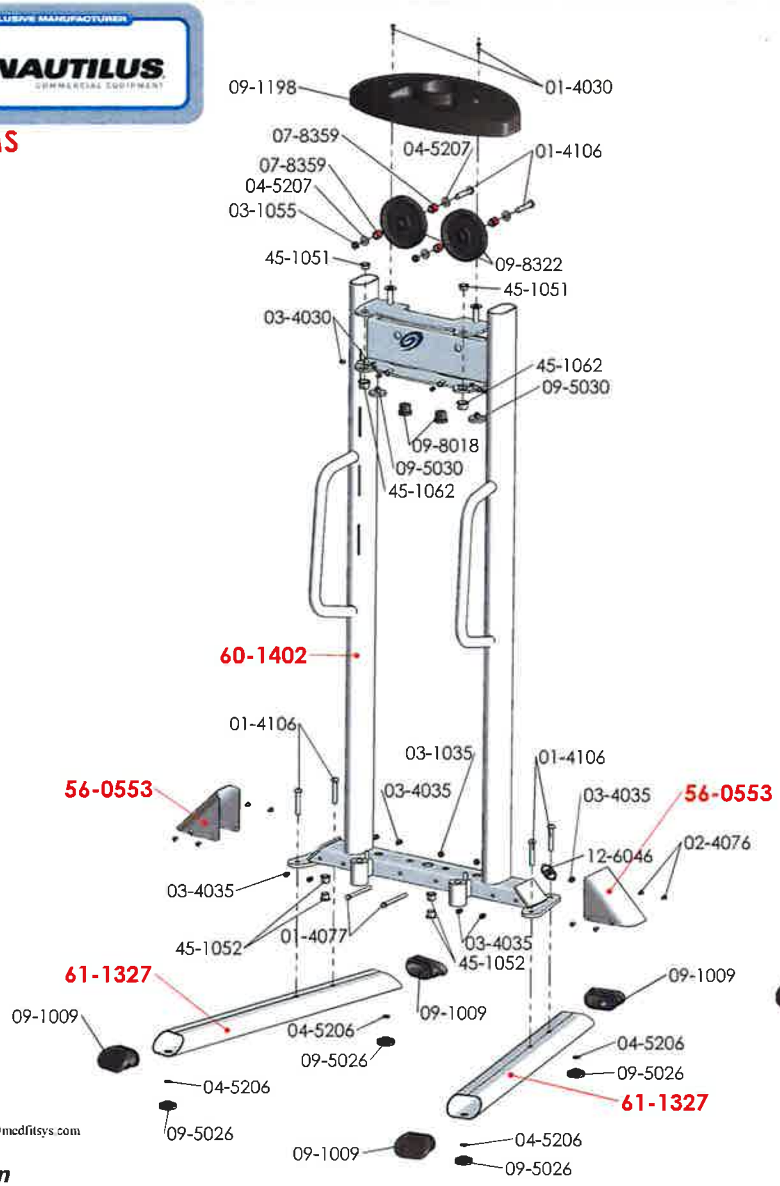

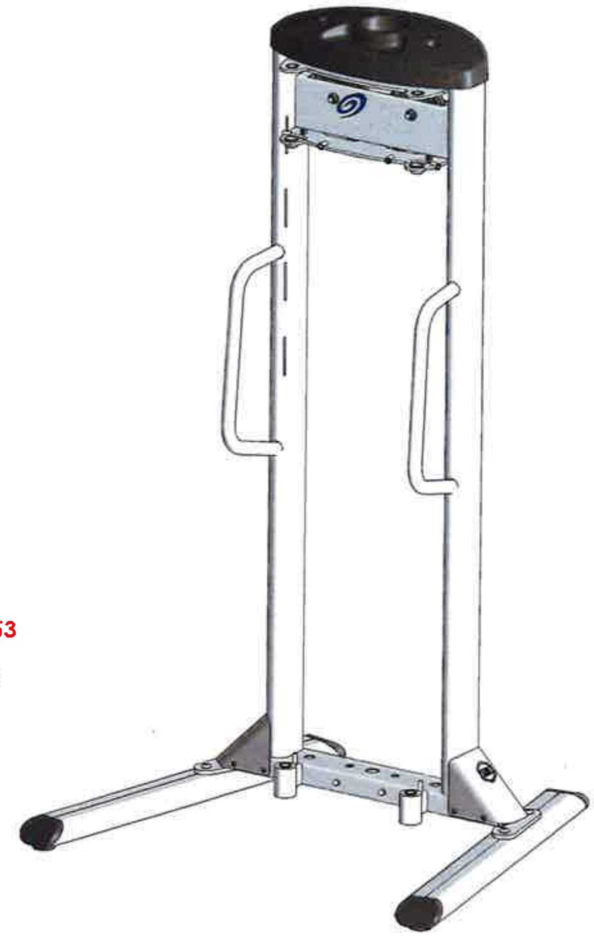

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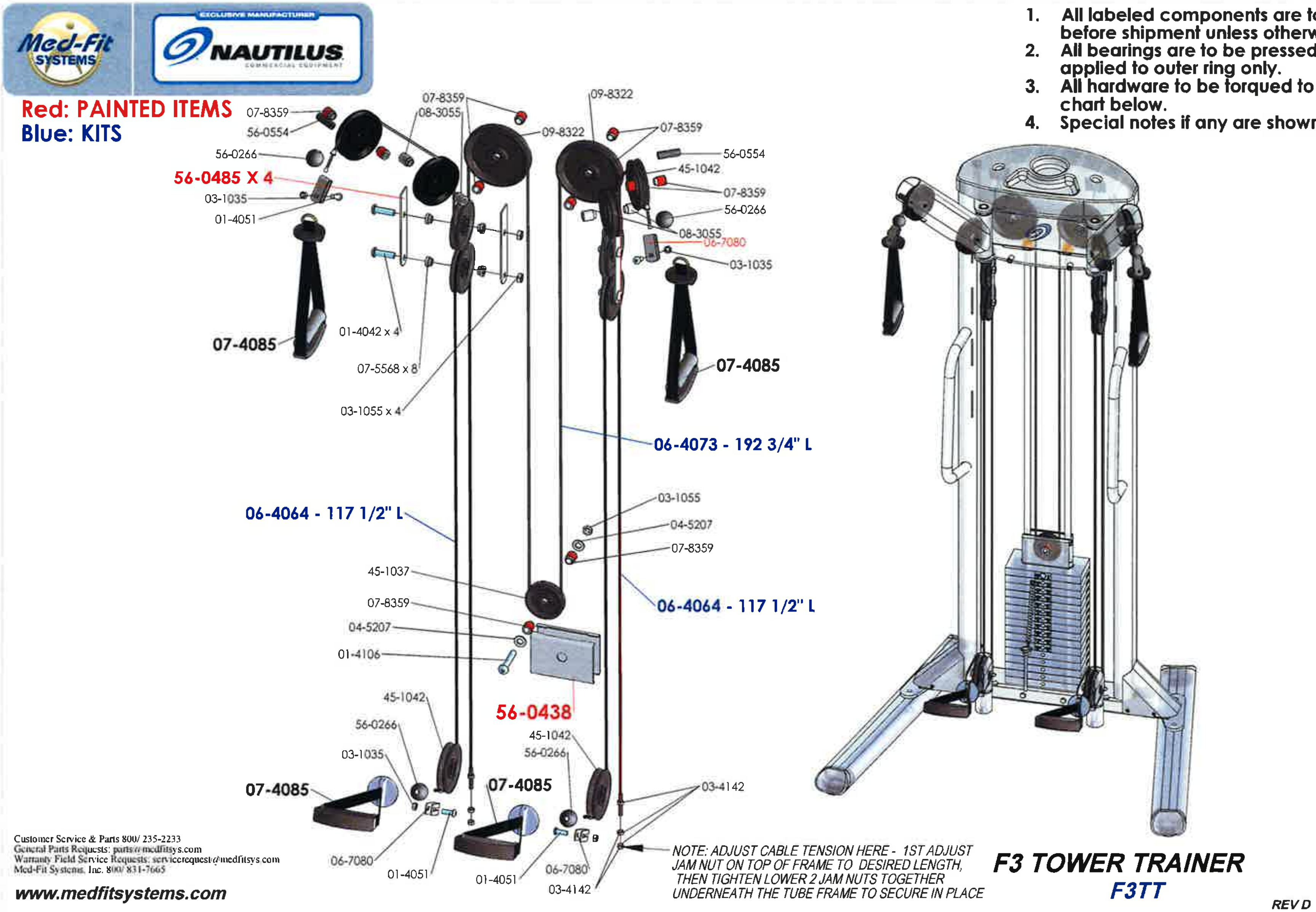

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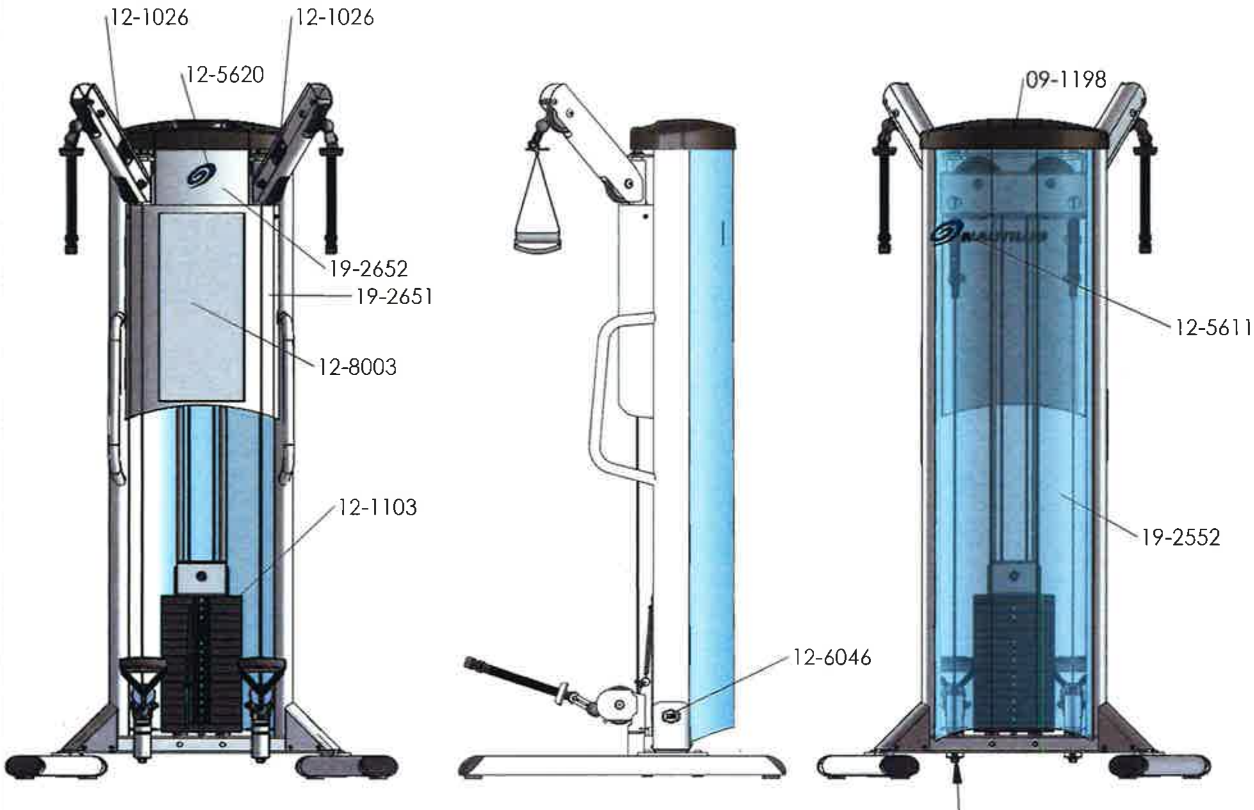

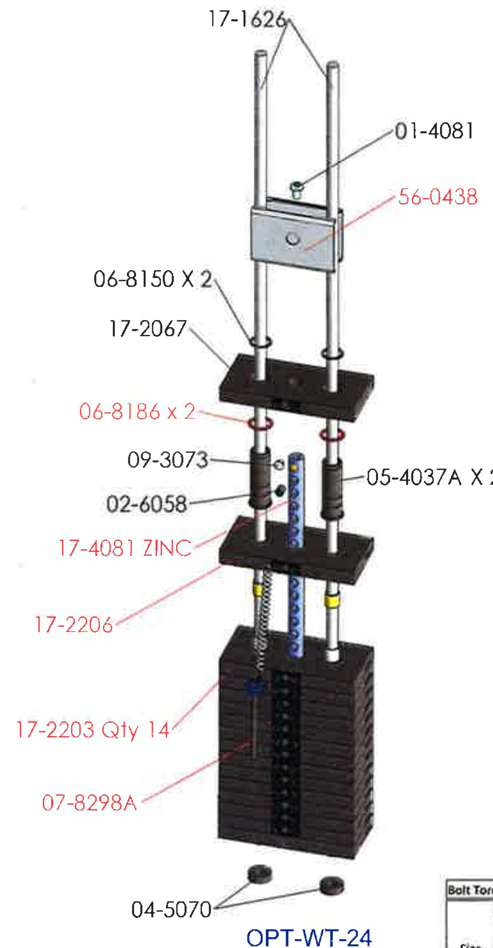

NOTE: ADJUST CABLE TENSION HERE - 1ST ADJUST JAM NUT ON TOP OF FRAME TO DESIRED LENGTH, THEN TIGHTEN LOWER 2 JAM NUTS TOGETHER UNDERNEATH THE TUBE FRAME TO SECURE IN PLACE

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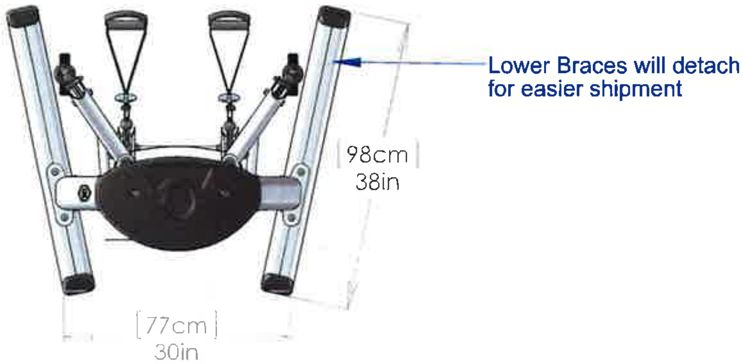
Nautilus Exhibit 1007

APPENDIX V



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10/5/12	F3TT
Units	**Weight**
lbs	346
kg	157

F3 TOWER TRAINER

F3TT

REV D

United States Patent [19]
Jensen

[11] **Patent Number: 4,867,443**
[45] **Date of Patent: Sep. 19, 1989**

[54] **CROSS-COUNTRY SKIING SIMULATOR**

[75] Inventor: **Hans C. Jensen,** Vancouver, Canada

[73] Assignee: **Altero Technologies, Inc.,** Richmond, Canada

[21] Appl. No.: **168,880**

[22] Filed: **Mar. 16, 1988**

[51] **Int. Cl.**[4] **A63B 21/00;** A63B 1/00

[52] **U.S. Cl.** **272/97;** 272/70; 434/253

[58] **Field of Search** .... 272/97, 70, 128, 131, 272/132, 133, 73; 434/253, 255; 128/25 R, 25 B

[56] **References Cited**

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4,434,981 3/1984 Norton 272/97
4,645,201 2/1987 Evans 272/97
4,679,786 7/1987 Rodgers 272/70

FOREIGN PATENT DOCUMENTS

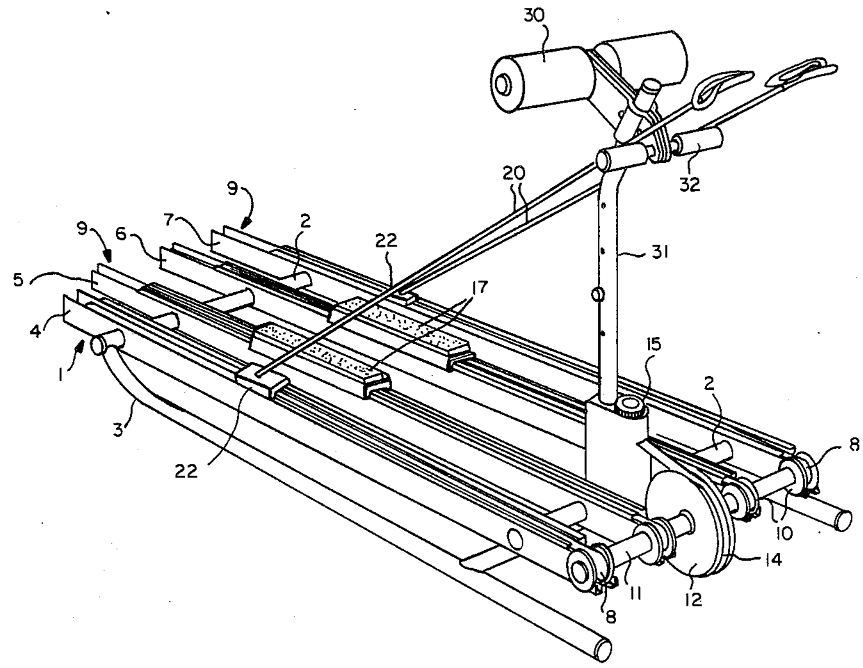
2631897 1/1978 Fed. Rep. of Germany 272/97

Primary Examiner—S. R. Crow
Attorney, Agent, or Firm—Flehr, Hohbach, Test, Albritton & Herbert

[57] **ABSTRACT**

An exercise machine for simulating cross-country skiing is disclosed in which the poling action of the arms and the leg action both drive the same flywheel through a system of overrunning clutches. This provides a more realistic simulation of cross-country skiing than the prior art devices in which the arm motion was independent of the leg action.

10 Claims, 2 Drawing Sheets



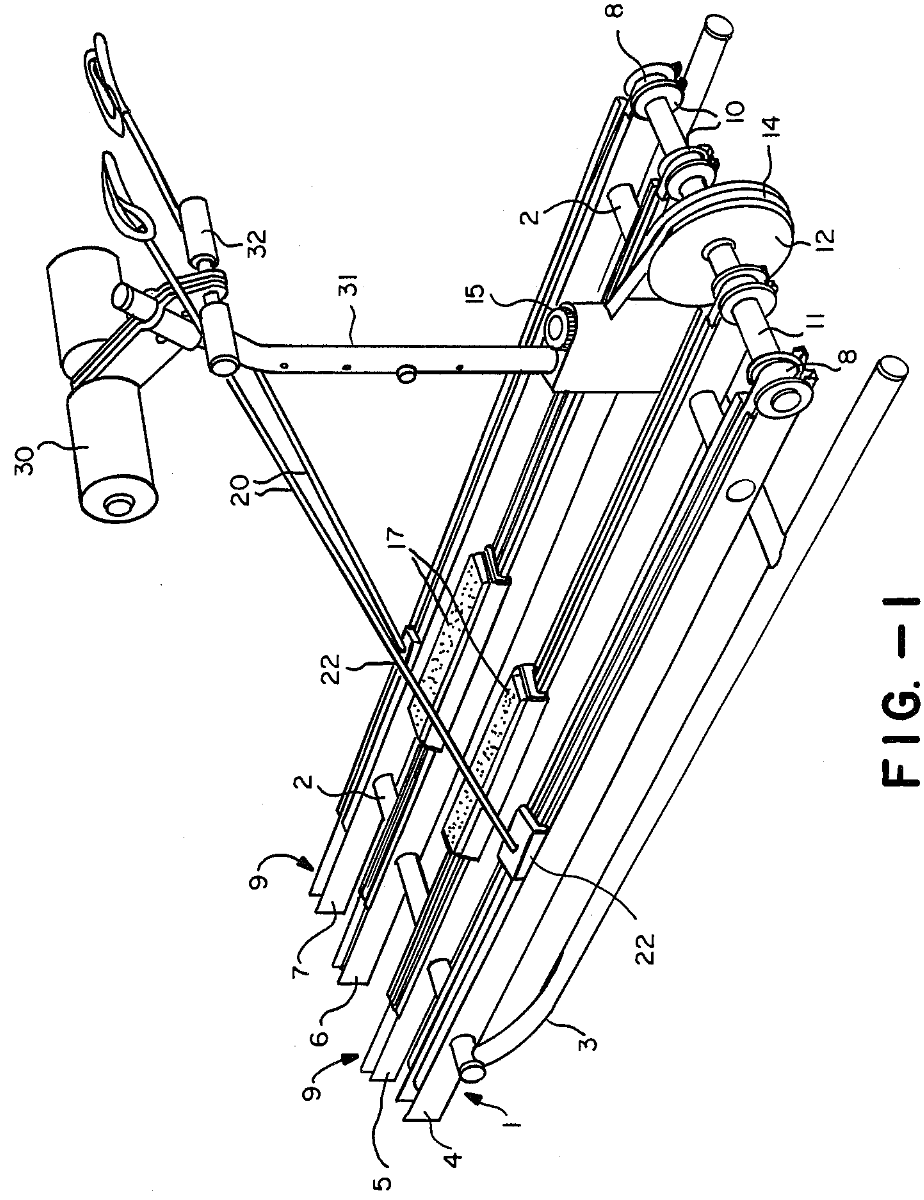


FIG. — I

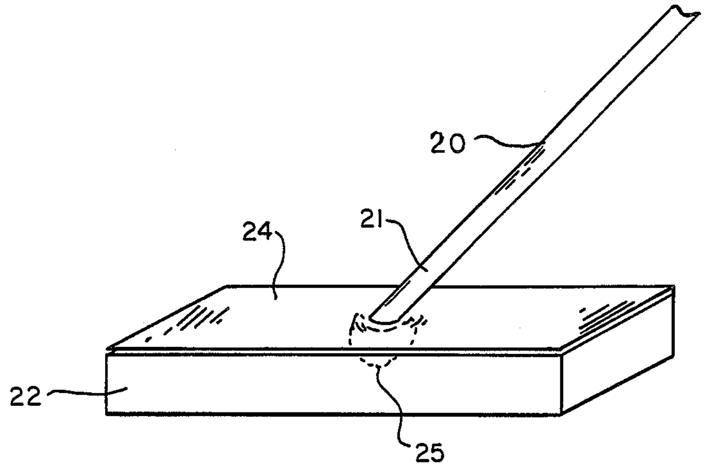


FIG. -2

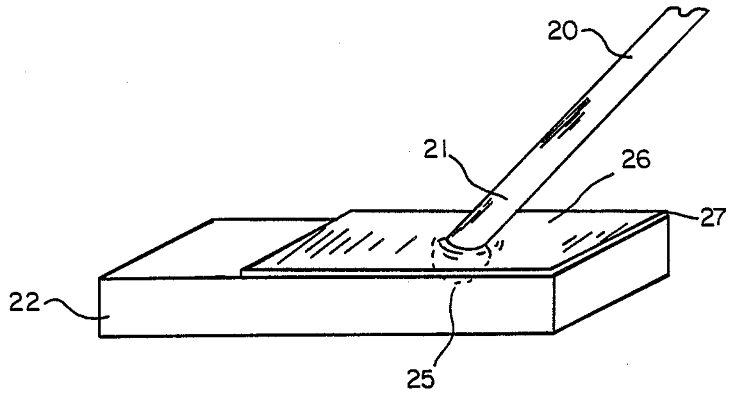


FIG. -3

CROSS-COUNTRY SKIING SIMULATOR

BACKGROUND OF THE INVENTION

The invention relates to exercise apparatus which simulate cross-country skiing.

Various apparatus have been designed to permit cross-country skiers to exercise the muscles necessary for the sport in a stationary location indoors in a gymnasium or the like The purpose of such apparatus is to simulate as closely as possible the movements involved in actual cross-country skiing In the past, such devices have typically included a pair of foot plates mounted on a pair of tracks extending along a base frame. The foot plates connect to endless belts which in turn drive a flywheel. See for example U.S. Pat. No. 4,659,077 issued Apr. 21, 1987 to Fitness Quest Inc., U.S. Pat. No. 4,645,201 issued Feb. 24, 1987 to Tekron Licencing B.V., U.S. Pat. No. 4,434,981 issued Mar. 6, 1984 to Desmond Norton, U.S. Pat. No. 4,023,795 issued May 17, 1977 to Edward Pauls, U.S. Pat. No. 3,941,377 issued Mar. 2, 1976 to Hakon Lye, and the product currently sold under the trademark NORDIC TRACK.

In order to provide simultaneous exercise for the arms through poling motion, such devices have typically had a separate pulley or spring system for each arm which operates independently of the leg motion. The problem with such apparatus is that they do not adequately simulate the sensation of cross-country skiing. In actual cross-country skiing, the energy transmitted through the ski poles creates a gliding sensation which in turn affects the way in which force is transmitted through the leg action. In the prior art devices, however, the amount of exertion applied to the poling action has no effect on the resistance presented to the leg motion. Consequently, the user does not receive the same sensation as actual cross-country skiing and the amount of exercise which the various muscles receive will likely differ from actual skiing. For example, in actual cross-country skiing, the skier may "double pole" for a period of time to build up his momentum. Once he recommences his leg motion, he will already be gliding with some momentum However, in the prior art exercise apparatus, the double-poling motion would not generate any momentum in the flywheel which is driven by the leg motion of the person exercising.

The present invention provides an exercise apparatus for simulating cross-country skiing in which both the poling action and leg action transmit energy to a single flywheel so that the user receives a more realistic simulation of cross-country skiing.

SUMMARY OF THE INVENTION

The present invention provides an exercise apparatus for simulating cross-country skiing which comprises a pair of foot plates running in parallel tracks, each attached to an endless belt, and a pair of sliding plates attached to the tips of two ski poles running in parallel tracks on either side of the foot plate tracks, with each of the pole plates also attached to an endless belt. Each of the four endless belts drives a common drive shaft through overrunning clutches A flywheel is connected to the drive shaft and means may be provided for adjusting the resistance applied to the flywheel.

BRIEF DESCRIPTION OF THE DRAWINGS

In drawings which illustrate a preferred embodiment of the invention:

FIG. **1** is a perspective view of the exercise apparatus of the invention;

FIG. **2** is a detailed view of the pole plate of a first embodiment of the invention; and

FIG. **3** is a detailed view of a second embodiment of the pole plate of the invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIG. **1**, the exercise apparatus of the invention is designated generally as **1**. The device has a base **3** which supports four parallel tracks **4**, **5**, **6** and **7**. The four tracks are held in rigid relationship by cross bars **2** which are in turn fixed relative to base **3**. Mounted within each track is an endless belt **8** which runs around a pulley **9** at the rear end of the device and a pulley **10** provided with an overrunning clutch at the front end of the device. Each overrunning clutch is mounted on drive shaft **11** so that movement of the belt **8** in the clockwise direction in FIG. **1** will cause the clutch to freewheel while movement of the belt in the counter-clockwise direction will cause drive shaft **11** to rotate. A suitable overrunning clutch is the bearing manufactured and sold under the trademark "TORRINGTON CLUTCH BEARINGS."

Mounted on drive shaft **11** is a heavy flywheel **12**. Friction can be applied to flywheel **12** using a friction belt **14** in a known fashion. The tension on belt **14** can be adjusted by knob **15** which will increase or decrease the tightness of belt **14** against the flywheel and thereby allow the user to vary the resistance to motion of the endless belts.

The two central tracks **5** and **6** have mounted thereon foot plates **17** which have a high friction upper surface and are connected to belts **8**. Foot plates **17** may slide on tracks **5** and **6** on rollers or on a pad of low friction material such as TEFLON. Means can be provided to oil the point of contact between the foot plates **17** and the surface of the track. Foot plates **17** can have straps to secure the user's feet or the user's feet may be secured simply by friction, by providing a high friction grit surface on the pad and possibly also by providing a slight forward slope to the plate.

Ski poles **20** have tips **21** which are secured to ski pole plates **22**. The two plates **22** are in turn fixed to endless belts **8** and slide on tracks **4** and **7** respectively, either on rollers or a surface of low-friction material. In the embodiments shown in FIG. **2**, tip **21** is secured to a thick rubber sheet **24** which is secured at both ends to plate **22**. In the embodiments shown in FIG. **3**, tip **21** is secured to thick rubber sheet **26** which in turn is secured only at its forward end **27** to plate **22**. In this way, the pole will drive the plate backwards when pressure is applied, but it is free to rotate in any direction about the end of tip **21**. Tip **21** may be secured to the rubber sheet **24** or **26** by an enlarged ball **25** which is secured to the end of the tip and is forced through a hole in the rubber sheet, thereby creating a universal joint. Hip pad or bumper **30** is supported on column **31**. The height of hip pad **30** is adjustable. Handles **32** are also provided for use of the machine without the poles.

To use the machine, the user adjusts the height of hip bumper **30** so that it rests against his hip at a comfortable location. The user places his feet on the two foot plates **17** and grasps the handles of ski poles **20**. (If the user desires, he may simply use the leg exercise aspect of the machine and grasp handles **32** with his hands.) The user applies force in the rearward direction on the poles **20** and on the foot pads **17**, using the same motions one would use in cross-country skiing, including double-poling. Due to the one-way clutches **8**, rearward motion by any one or more of the pole plates **22** or foot plates **17** will cause flywheel **12** to rotate Flywheel **12** typically will have a weight of about **16** pounds and so will generate some momentum. The amount of resistance on the flywheel can be varied by tightening belt **14** using knob **15** to simulate a more difficult course. Similarly, the entire plane of the tracks **4, 5, 6** and **7** can be tilted upwardly, either by raising the front end of the apparatus or lowering the rear end, in order to simulate an uphill situation and also to remove some of the pressure against hip pad **30**. The hip bumper **30** keeps the user's body stationary despite the rearwardly-directed forces

It will be seen that any work done by the user will be translated into rotation of the flywheel and thus the effect of gliding is created. Various modifications of the design will be apparent to those skilled in the art. For example, nylon ropes could be substituted for the belts **8** shown in FIG. **1**. However, the scope of the invention is to be defined in terms of the accompanying claims.

The invention has been described herein with reference to certain preferred embodiments. However, as obvious variations thereon will become apparent to those skilled in the art, the invention is not to be considered as limited thereto.

What is claimed is:

1. An exercise apparatus for simulating cross-country skiing, comprising:

a) a base frame having front and rear ends;

b) four parallel, substantially horizontal tracks mounted on said base frame to extend between said front and rear ends and forming an inner pair and an outer pair of tracks;

c) a drive shaft mounted for rotation adjacent said front end of said frame;

d) two pulleys associated with each track, said pulleys being mounted for rotation at separate locations adjacent opposite ends of each said track, a first pulley mounted on said drive shaft and a second pulley mounted adjacent the rear end of said frame;

e) endless belt means mounted in association with each said track for motion around said pulleys;

f) two foot-receiving plates mounted for sliding motion one on each of the two of said horizontal tracks forming the inner pair of tracks, and each secured to its respective endless belt means;

g) two pole-receiving plates mounted for sliding motion one on each of the two of said horizontal tracks forming the outer pair of tracks, and each secured to its respective endless belt means;

h) two ski poles;

i) means fixed to said pole-receiving plates and to the lower ends of said ski poles providing a pivotable connection between said pole-receiving plates and said lower pole ends;

j) one-way clutch means linking each said first pulley to said drive shaft whereby motion of said belt is freely permitted in one direction but motion of said belt means in the opposite direction drives said drive shaft; and

k) a flywheel mounted on said drive shaft.

2. The exercise apparatus of claim **1** further comprising means for applying variable resistance to said flywheel.

3. The exercise apparatus of claim **1** further comprising upstanding means for contacting the body of a user of the apparatus and resisting the forward motion of said user.

4. The exercise apparatus of claim **1** wherein said means for fixing said ski pole tips lower pole ends to said pole-receiving plates comprises a sheet of elastomeric material provided with an aperture for receiving said ski pole tip lower pole end.

5. The exercises apparatus of claim **1** wherein said pivotable connection is a universal connection.

6. An exercise apparatus for simulating cross-country skiing, comprising:

(a) a base frame having front and rear ends;

(b) four parallel, substantially horizontal tracks mounted on said base frame to extend between said front and rear ends and forming an inner pair and an outer pair of tracks;

(c) a drive shaft mounted for rotation in said frame;

(d) two pulleys associated with each track, said pulleys being mounted for rotation at separate locations, one of said pulleys mounted on said drive shaft;

(e) endless belt means mounted in association with each said track for motion around said pulleys;

(f) two foot-receiving plates mounted for sliding motion one on each of the two of said horizontal tracks forming the inner pair of tracks, and each secured to its respective endless belt means;

(g) two pole-receiving plates mounted for sliding motion one on each of the two of said horizontal tracks forming the outer pair of tracks, and each secured to its respective endless belt means;

h) two ski poles;

i) means fixed to said pole-receiving plates and to the lower ends of said ski poles providing a pivotable connection between said pole-receiving plates and said lower pole ends;

j) one-way clutch means linking each said first pulley to said drive shaft whereby motion of said belt means is freely permitted in one direction but motion of said belt means in the opposite direction drives said shaft; and

k) a flywheel mounted on said drive shaft.

7. The exercise apparatus of claim **6** further comprising means for applying variable resistance to said flywheel.

8. The exercises apparatus of claim **6** further comprising upstanding means for contacting the body of a user of the apparatus and resisting the forward motion of said user.

9. The exercises apparatus of claim **6** wherein said means for fixing said lower pole ends to said pole-receiving plates comprises a sheet of elastomeric material provided with an apparatus for receiving said lower pole end.

10. The exercises apparatus of claim **6** wherein said pivotable connection is a universal connection.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 4,867,443

DATED : September 19, 1989

INVENTOR(S) : Jensen, Hans C.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 62, delete "apparatus" and insert ---aperture---.

Signed and Sealed this

Eighteenth Day of September, 1990

Attest:

HARRY F. MANBECK, JR.

Attesting Officer

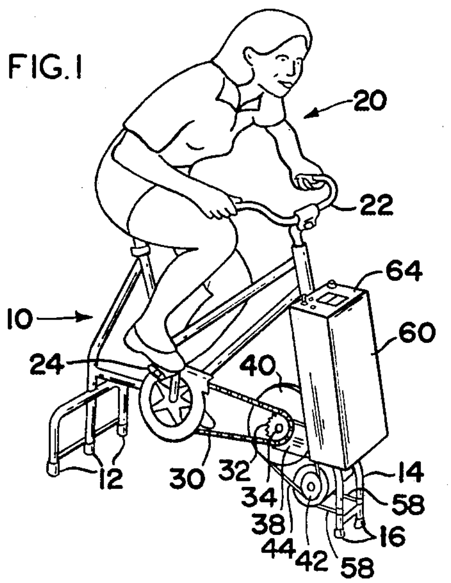
Commissioner of Patents and Trademarks

May 12, 1970 G. CORWIN 3,511,097

EXERCISE APPARATUS

Filed Sept. 29, 1967 3 Sheets-Sheet 1

FIG. 1



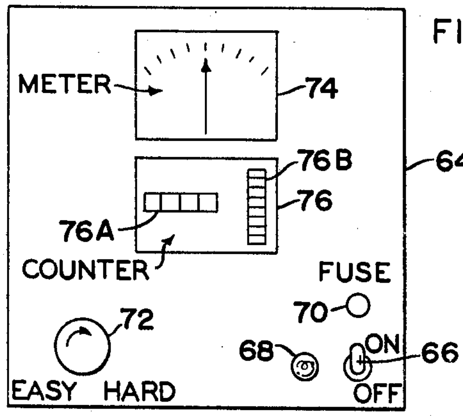
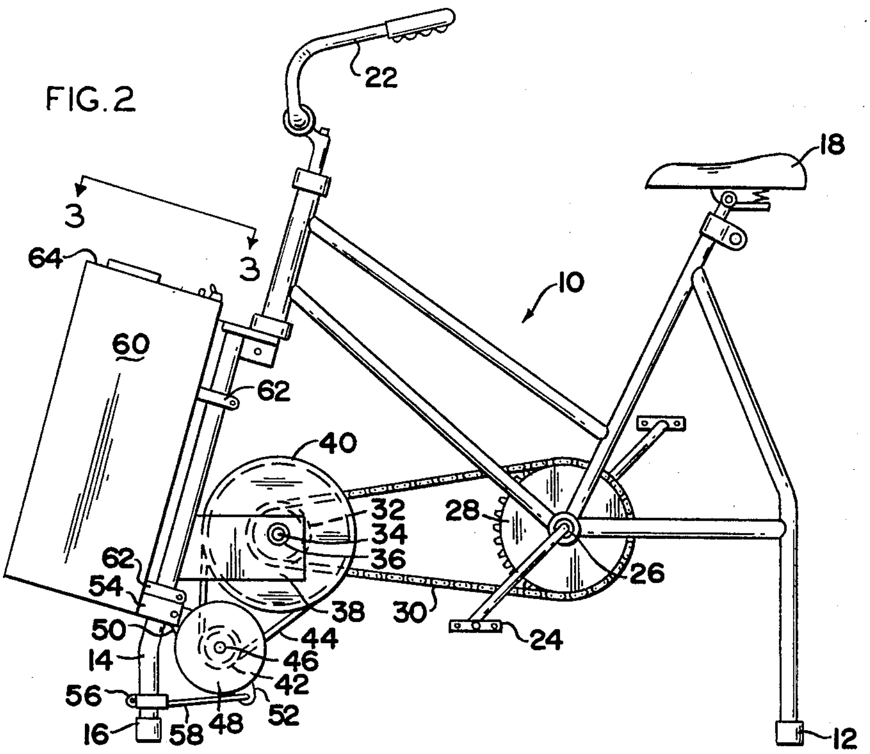


FIG. 3

FIG. 2



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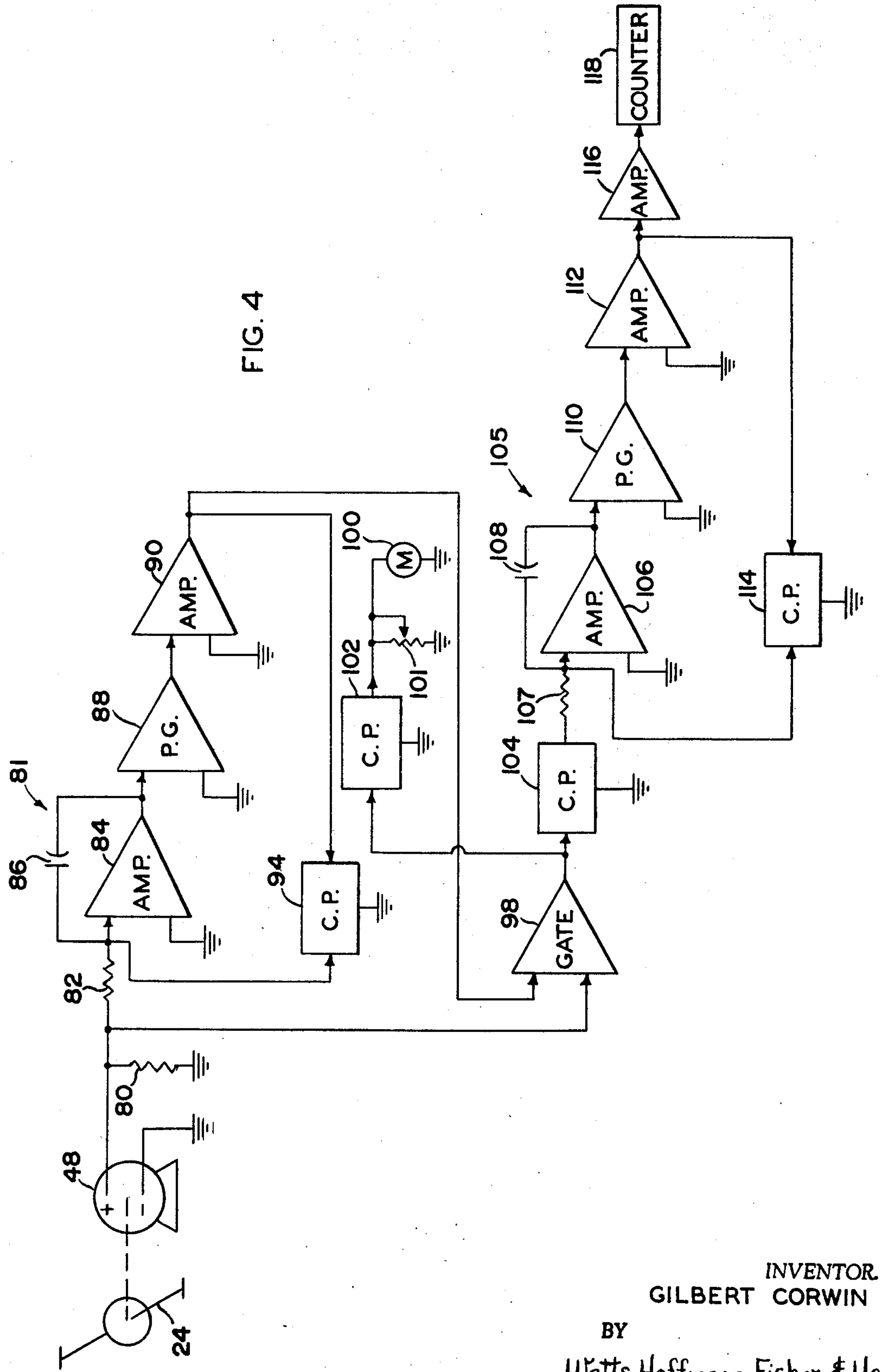
May 12, 1970 G. CORWIN 3,511,097

EXERCISE APPARATUS

Filed Sept. 29, 1967 3 Sheets-Sheet 2

FIG. 4



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APPENDIX X

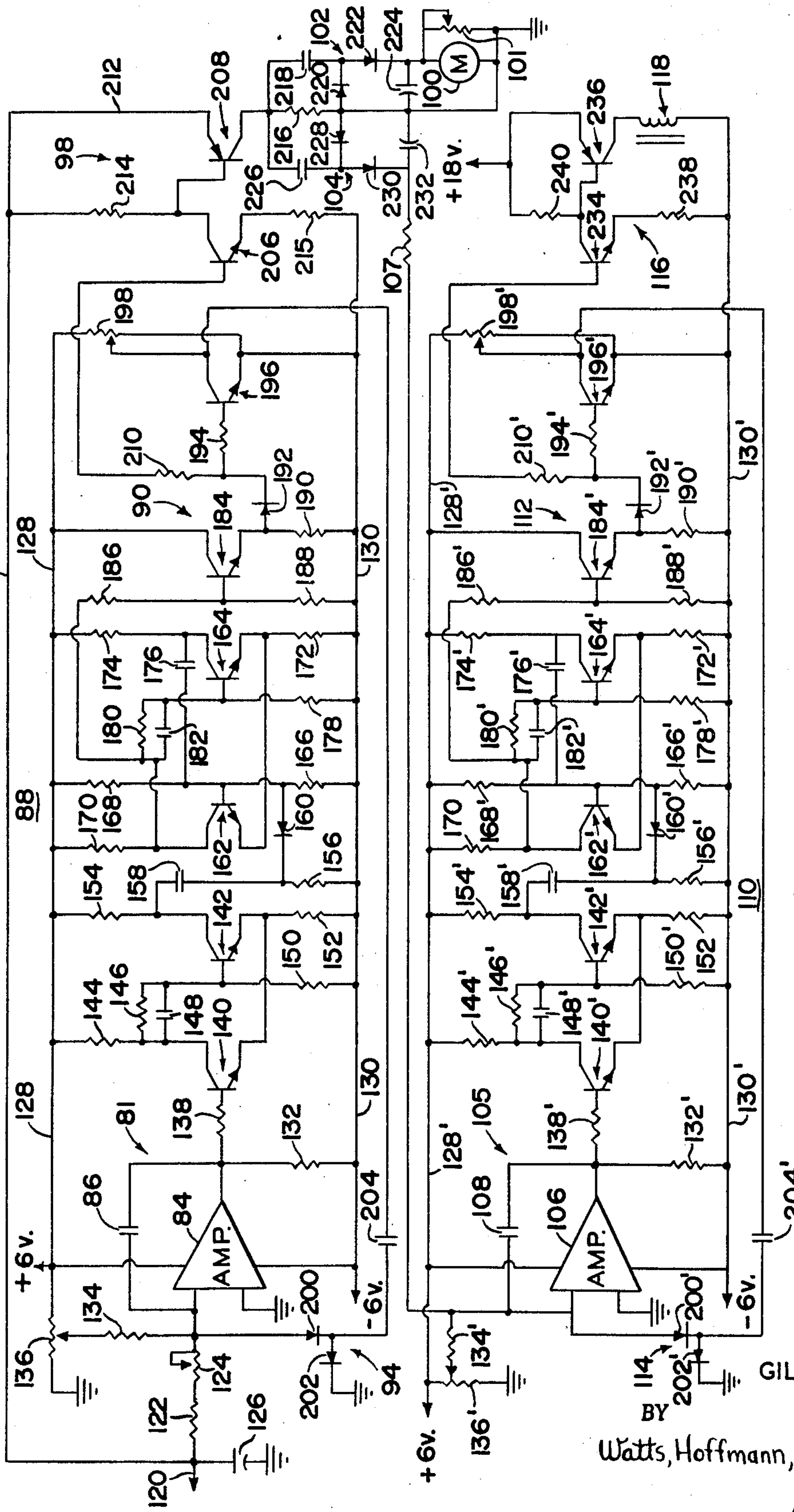

FIG. 5

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United States Patent Office 3,511,097 Patented May 12, 1970

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3,511,097

EXERCISE APPARATUS

Gilbert Corwin, 2403 Elmwood Drive, Westlake, Ohio 44145

Filed Sept. 29, 1967, Ser. No. 671,853
Int. Cl. G01l 5/02
U.S. Cl. 73—379 26 Claims

ABSTRACT OF THE DISCLOSURE

The apparatus comprises a bicycle-like device, which is pedalled by a person using the apparatus. Pedalling rotates the armature of a generator, and the output of the generator energizes electronic circuitry. Means are provided in the circuitry for indicating the rate at which food calories are being expended, as well as means for indicating the total number of food calories expended as an exercise period progresses. The electronic circuitry includes two current integrators with means for re-cycling the integrators to provide the two output indications.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to exercise apparatus, and, more particularly, to such apparatus embodying electronic circuitry for indicating the rate at which food calories are being expended by a user, as well as means for indicating a cumulative total of food calories expended as an exercise period progresses.

Discussion of the prior art

Various devices have been proposed heretofore that have measured in one fashion or another the energy expended by a user. Most of these devices have been applicable to medical applications, where a patient must exert a certain, predetermined amount of energy, while undergoing diagnostic examinations such as the making of electrocardiograms, etc. In such an application, there is no need for precisely determining the rate at which energy is being expended or the total amount of energy expended at any given time after the start of the program. It has been sufficient merely to know that at least a certain amount of energy is being expended.

In another known device of this general type, a patient mechanically rotates a generator of a motor-generator unit. The motor is caused to rotate at a desired speed by electrical energization, and the patient is instructed to rotate the generator at the same speed as the motor. The output of the generator is read on a watt meter. As the rotational speed of the motor is reduced by reducing its electrical energization, the patient must exert more energy to maintain the original rotational speed of the motor. Such additional energy expended by the patient can be measured by the watt meter.

In still another device, means are provided for indicating the amount of human energy delivered to the device in a certain interval of time. Integrating means are provided for obtaining a measure of the cumulative energy delivered to the work load, such a measure being provided by a digit wheel counter. Means are also provided for giving a very general indication of the rate at which work is being performed. The entire apparatus is strictly mechanical in nature, however, and so is subject to the inaccuracies and breakdown problems inherent in such mechanical apparatus.

Accordingly, it is a general object of the present invention to provide exercise apparatus, in which the rate at which food calories are being expended by a user

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is precisely indicated and in which the cumulative total of food calories expended is also precisely indicated.

It is another general object of the invention to provide exercise apparatus, in which the measuring and indications means are entirely electronic in nature and preferably comprise solid state devices rather than electron discharge devices.

SUMMARY OF THE INVENTION

A user of apparatus embodying the invention sits on a bicycle-like stand and rotates the armature of an electric generator mechanically coupled to pedals of the apparatus. The output of current of the generator passes through a load resistor, the voltage across which is provided to a first integrating circuit. The output of the first integrating circuit energizes a first pulse generator, which produces a first series of pulses at a rate proportional to the voltage across the generator load resistor. These pulses along with the generator load voltage are supplied to circuitry that provides an output current proportional to the power delivered by the generator. This current is converted into units of food calories being expended and indicated on a meter.

The signal that energizes the aforementioned meter is also used to operate a second integrating circuit to provide a second series of pulses whose rate is a function of the generator power output. Each output pulse of the second series represents a unit of power delivered to the load, and, by proper adjustment of circuit constants, can be made equal to a desired number of food calories or fraction of a food calorie. The second series of pulses is utilized to actuate a counter to indicate a cumulative total of food calories expended since the start of an exercise period.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of exercise apparatus embodying the invention;

FIG. 2 is an elevational view of the apparatus of FIG. 1;

FIG. 3 is a plan view of the indicator and control panel shown in FIG. 1 and taken on the line **3—3** of FIG. 2;

FIG. 4 is a block diagram of the electronic portion of the apparatus; and

FIG. 5 is a schematic diagram of the electronic portion shown in block diagram form in FIG. 4.

DESCRIPTION OF A PREFERRED EMBODIMENT

As shown in FIGS. 1 and 2, exercise apparatus embodying the invention comprises a stationary bicycle-like stand **10** having rear feet **12** and a front fork **14** resting on front feet **16**. The stand supports a bicycle seat **18** on which a user **20** of the apparatus sits and holds handlebars **22**. The stand **10** is also provided with conventional bicycle pedals **24**, which are keyed or otherwise secured to a shaft **26** rotatably mounted in bearings (not shown) in the frame. A sprocket wheel **28** is mounted on the shaft **26** for rotation with the shaft, and drives a conventional link chain **30**. The chain **30** engages and drives another sprocket wheel **32**, which is mounted on and rotates a shaft **34**. The shaft **34** is mounted for free rotation in conventional bearings **36** supported in a U-shaped bracket **38** that is welded or otherwise secured to the front fork **14** of the stand **10** and extends rearwardly from the fork.

A V-pulley **40** is also mounted for rotation with the shaft **34**, and drives a smaller V-pulley **42** by means of a belt **44**. The V-pulley **42** is secured to a rotatable armature shaft **46** of an electrical generator **48**. The generator **48** is provided with two pairs of lugs **50**, **52**. Each of the upper lugs **50** is pivotally secured between the ends of a strap **54** that encircles one of the legs of the fork **14**. The weight of the generator is supported by the upper lugs **50** and straps **54**. Some movement of the pulley **42** toward and away from the pulley **40** is required in order to change the belt **44** and to adjust the belt tension. This movement is provided by a pair of straps **56**, each of which encircles a leg of the fork **14**, and may be adjusted upwardly and downwardly on a respective leg of the fork. A pair of rods **58** are provided, each of which has one end retained by a respective strap for limited pivotal movement about a horizontal axis, and another end secured in a lug **52** for pivotal movement about a horizontal axis. Thus, as the straps **56** are moved upwardly and downwardly on the fork **14**, the generator **48** will pivot about a horizontal axis defined by the pivotal connections of the lugs **50** to the straps **54**. This motion of the generator permits increasing and decreasing the tension on the belt **44** connecting the pulleys **40, 42**.

The electronic circuitry embodied in apparatus of the invention is completely contained within a case **60**, which is secured to the front fork **14** by means of straps **62**. A portion of the case **60** may be removable to permit access to the electronics for testing and maintenance purposes.

The case **60** has a top panel **64** within easy view of a user of the apparatus, which panel is shown in FIG. 3. The top panel **64** has mounted thereon an ON-OFF switch **66**, an ON-OFF indicator light **68**, and a fuse **70**. It also has a knob **72** for adjusting the excitation of the field winding of the generator, thereby to adjust the mechanical resistance to pedalling and rotating the generator. In other words, the less field excitation, the less the energy required to turn the generator armature and the less the output voltage from the armature. Of course, the converse is also true.

A meter **74** and a numerical counter **76** are also mounted on the top panel **64**. The meter **74** may be calibrated in food calories to indicate the rate at which such calories are being expended. The counter **76** has a dial **76**A that indicates the cumulative total of food calories (or multiples of units of food calories) expended since the start of an exercise period. The counter **76** has a knurled RESET wheel **76**B for re-setting the counter dial to zero at the start of an exercise period.

FIG. 4 is a block diagram of the electronic portion of apparatus embodying the invention. As shown schematically, the pedals **24** mechanically drive the armature of the generator **48** to produce an output votlage across a fixed load resistor **80**. The voltage appearing across the load resistor **80** is provided to an integrating amplifier **81** comprising an input resistor **82**, an operational amplifier **84**, and a feedback capacitor **86**. The amplifier **84** is of conventional commercial design and availability; a suitable amplifier is available from Motorola Inc., Chicago, Ill., and is known as Model MC 1709 CG, although certainly the invention is not limited to the use of any particular amplifier.

It will be helpful at this point to consider the basic definitions on which the utility of the present invention is predicated. First, a food calorie (or large calorie) is equal to a kilogram-calorie, or 4183 joules. Second, an electrical load absorbing approximately 70 watts for one minute has absorbed 4200 joules, or approximately one kilogram-calorie. Thus, the rate at which power is absorbed by an electrical load can be used as a measure of the rate at which food calories are being expended, and the cumulative total of power absorbed is a measure of the cumulative total of food calories expended in a given period. The rate at which power is absorbed by the electrical load is proportional to the square of the voltage drop across the load (E^2), and the integral of that quantity with respect to time is proportional to cumulative power absorbed.

As shown in FIG. 4, the operational amplifier **84** is provided with the feedback capacitor **86**, which integrates the current flowing through the resistor **82** into the amplifier. The output of the amplifier **84** is connected to the input of a pulse generator **88** comprising a Schmitt trigger circuit, a monostable multivibrator and an output buffer amplifier, the latter components not being individually shown in FIG. 4. So far as the block diagram is concerned, it is sufficient to note that as a charge accumulates across the capacitor **86**, the output of the amplifier **84** changes. When the output of the amplifier has reached a predetermined level, the Schmitt trigger in the pulse generator **88** is actuated, which, in turn, actuates the monostable multivibrator to produce a first pulse of predetermined width. This pulse is buffered by the buffer amplifier in the pulse generator **88**, and then provided as a positive pulse to an output amplifier **90**.

A negative output pulse from the amplifier **90** is provided to a "charge pump" circuit **94** connected to the input of the integrating amplifier **81**. The negative pulse supplied from the amplifier **90** to the charge pump **94** causes the capacitor **86** to discharge by an amount sufficient to de-actuate the Schmitt trigger and reset it. This cyclic action will continue so long as there is current flow into the integrating amplifier **81**. Because the amount of charge pumped away for each cycle is the same, the repetition rate of the output pulses from the output amplifier **90** is a function of the voltage applied across the load resistor **80** from the generator **48**.

The output of the amplifier **90** is also supplied to one input of a voltage amplitude gate **98**. A second input signal is provided to the gate **98** from across the load resistor **80**. The voltage amplitude gate **98** comprises a driver and a power transistor, with the output of the power transistor being a first series of pulses whose repetition rate is directly proportional to the voltage developed across the generator load resistor **80**, and whose amplitudes are similarly directly proportional to the generator load voltage.

The first series of pulses provided from the amplitude gate **98** is used for two purposes. First, the pulses are utilized to energize a meter **100** connected across a calibrating variable resistor **101**, which meter indicates the rate at which food calories are being expended. Second, they are provided through a charge pump to a second integrator and charge pump to provide a second series of pulses whose repetition rate is a function of the generator power output. The first series of pulses is applied to the meter **100** through a charge pump **102**, and is applied through a charge pump **104** to an integrating amplifier **105** comprising an operational amplifier **106**, an input resistor **107**, and a feedback capacitor **108**. In both cases, the charge transferred through the charge pumps **102, 104** is proportional to the square of the voltage drop across the load resistor **80** and hence is proportional to the power being delivered by the generator **48** (assuming that the resistor **80** is fixed in value).

The integrating amplifier **105** and the succeeding circuits operate in essentially the same fashion as those previously described. The operational amplifier **106** is provided with the integrating feedback capacitor **108**, and the output of the amplifier **106** modified by the charge built up across the capacitor **108** is supplied to a pulse generator **110**. The pulse generator **110** comprises a Schmitt trigger, a monostable multivibrator, and a buffer amplifier, like the pulse generator **88** previously described. An output amplifier **112** receives the output of the pulse generator **110**, and the output of the amplifier **112** actuates a charge pump **114** connected to the input of the integrating amplifier **105**. Thus, the output of the amplifier **112**, which is supplied to a driver amplifier **116**, is a second series of pulses whose repetition rate is a function of the generator power output. By proper selection of circuit constants, each pulse of the second series of pulses can be made to represent a desired multiple (fractional or integral) of a food calorie. It has been found in practice that a convenient multiplier is 0.1, so that each pulse represents 418.3 watt seconds.

The second series of pulses, amplified by the amplifier **116**, is used to drive a conventional electromagnetic counter **118**, which registers one count for each pulse received. Thus, the reading of the counter **118** indicates at any time the cumulative total of food calories expended since the counter was reset at zero.

FIG. 5 is a schematic diagram of the circuitry shown in block diagram form in FIG. 4. A lead **120** connects the generator load resistor **80** (FIG. 4) through a fixed resistor **122** and a variable resistor **124** to the input of the operational amplifier **84** in the integrating amplifier **81.** A capacitor **126** connects the lead **120** to ground. Positive and negative operating potentials are supplied to the amplifier **84** and to the other circuit components from lines **128, 130** respectively connected to +6 volt and −6 volt supplies (not shown). The +6 volt and −6 volt power supplies are conventional and are energized from a conventional 110 volt alternating current household source.

The integrating capacitor **86** is connected between an inverting input terminal and the output of the amplifier **84.** Current flows through the resistors **122, 124** and into the capacitor **86.** As a positive charge accumulates on the plate of the capacitor **86,** the amplifier output appearing across a resistor **132** becomes increasingly negative. The resistor **132** is connected between the amplifier output and the −6 volt line **130.** Leakage current compensation that is required for accuracy is supplied to the input of the amplifier **84** through a resistor **134** from a movable arm of a potentiometer **136** connected between the +6 volt line **128** and ground.

The output voltage of the amplifier **84** is provided through a resistor **138** to the base of an NPN transistor **140.** The transistor **140** and another NPN transistor **142** comprise the Schmitt trigger which is part of the pulse generator **88** as previously mentioned. The collector of the transistor **140** is connected to the line **128** through a load resistor **144,** and to the base of the transistor **142** through a parallel combination of a resistor **146** and a capacitor **148.** The base of the transistor **142** is connected to the −6 volt line **130** through a resistor **150.** The emitters of the transistors **140, 142** are connected together and to the line **130** through a resistor **152.** The collector of the transistor **142** is connected to the +6 volt line **128** through a road resistor **154.** The output of the Schmitt trigger is taken across a resisor **156,** one end of which is connected to the line **130** and the other end of which is connected through a capacitor **158** to the collector of the transistor **142.**

The negative output of the Schmitt trigger is differentiated by the resistor **156** and the capacitor **158** and is coupled through a diode **160** to the base of an NPN transistor **162.** The transistor **162** and a second NPN transistor **164** comprise the monostable multivibrator previously referred to as being a part of the pulse generator **88.** The base of the transistor **162** is connected through a resistor **166** to the negative line **130** and through a resistor **168** to the positive line **128.** The collector of the transistor **162** is connected to the line **128** through a load resistor **170.** The emitters of the transistors **162, 164** are connected together and to the line **130** through a resistor **172.** The collector of the transistor **164** is connected through a load resistor **174** to the line **128.** Interaction between the transistors **162, 164** is accomplished by connecting the base of the transistor **162** to the collector of the transistor **164** through a capacitor **176,** and by connecting the base of the transistor **164** to the collector of the transistor **162** through a parallel combinaion of a resistor **180** and a capacitor **182.** The base of the transistor **164** is also connected to the line **130** through a resistor **178.**

base of an NPN transistor **184** through a resistor **186.** The

The collector of the transistor **162** is connected to the base of the transistor **184,** which serves as the buffer amplifier **90,** is also connected to the line **130** through a resistor **188.** The collector of the transistor **184** is connected directly to the positive line **128,** and the transistor emitter is connected to the negative line **130** through a resistor **190.** The positive output of the transistor **184** is taken from its emitter and supplied through a diode **192** and a resistor **194** to the base of an NPN transistor **196.** The emitter of the transistor **196** is connected directly to the negative line **130** and through a potentiometer **198** to the positive line **128.** A movable arm on the potentiometer **198** is connected to the collector of the transistor **196.** The collecor of the transistor **196** is also connected directly to the charge pump **94.**

The charge pump **94** comprises a pair of diodes **200, 202** connected in series to ground and the transistor **196.** The charge pump **94** also includes a capacitor **204** having one side connected to the juncture of the diodes **200, 202** and another side connected directly to the collector of the transistor **196.** The operation of the charge pump will be described later in connection with the operation of the overall circuit of which it is a part.

As previously mentioned, the voltage amplitude gate **98** receives input signals from the output of the pulse generator **88** and from the generator load resistor **80** (FIG. 4). As shown in FIG. 5, the amplitude gate comprises an NPN transistor **206** and a PNP transistor **208.** The base of the transistor **206** is connected through a resistor **210** to the juncture of the diode **192** and the resistor **194** in the buffer amplifier **184** to receive one input signal, and the emitter of the transistor **208** is connected to a lead **212** that is in turn connected to the input lead **120.** The collector of the transistor **206** and the base of the transistor **208** are connected together and to the lead **212** through a resistor **214.** The emitter of the transistor **206** is connected to the line **130** through a load resistor **215.** The collector of the transistor **208** is connected to ground through a load resistor **216.**

The output of the gate **98** is taken from across the load resistor **216** and applied to the charge pumps **102, 104.** The charge pump **102** comprises a capacitor **218** having one side connected to the collector of the transistor **208** (and hence, to the top of the load resistor **216**) and its other side connected to the cathode of a diode **220.** The anode of the diode **220** is connected to the grounded side of the resistor **216.** The juncture of the capacitor **218** and the diode **220** is connected to the anode of a diode **222,** whose cathode is connected through the meter **100** and parallel resistor **101** to ground. A filter or integrating capacitor **224** is connected across the meter **100.**

The charge pump **104** comprises a capacitor **226** having one side connected to the collector of the transistor **208** and its other side connected to the cathode of a diode **228.** The anode of the diode is grounded. The juncture between the capacitor **226** and the diode **228** is connected to the anode of a diode **230;** the cathode of the diode **230** is connected to ground through a filter or integrating capacitor **232.** The juncture between the diode **230** and the capacitor **232** is connected through the input resistor **107** to the input of the operational amplifier **106** and to the integrating capacitor **108** in the integrating amplifier **105.**

The portion of the electronic circuitry shown in the lower half of FIG. 5 is, except for its output components and connections, similar to the circuitry shown in the upper half of the figure. Therefore, those components appearing to the right of the integrating amplifier **105** that correspond to components shown in the upper half of the figure are designated by the same reference numerals with prime (′) suffixes. It is believed that the various connections of this portion of the circuitry will be apparent without a detailed explanation.

The output of the amplifier **112** in the lower portion of the circuitry is supplied to the driver amplifier **116** for energizing the actuating coil of the electromagnetic counter **118.** The driver amplifier **116** comprises an NPN transistor **234** and a PNP transistor **236.** The base of the transistor **234** is connected to receive the output signal of the amplifier **112** through a resistor **210′**. The emitter of the transistor **234** is connected to the negative line **130′** through a resistor **238**. The collector of the transistor **234** is connected directly to the base of the transistor **236** and to a source of +18 volts through a load resistor **240**. The emitter of the transistor **236** is connected directly to the +18 volt source, and the transistor collector is connected through the actuating coil of the counter **118** to the negative supply line **130′**.

The +18 volt power supply is conventional and it, in combination with the —6 volt supply, provides 24 volts to actuate the coil of the counter **118**.

When operation is initiated, or immediately after the integrating amplifier **81** has been recycled, the output voltage of the operational amplifier **84** is essentially at zero volts. This voltage transferred to the base of the transistor **140** in the Schmitt trigger circuit causes the transistor **140** to conduct, thus drawing current through and causing a voltage drop across the resistor **144** in its collector circuit. Thus, the voltage applied to the base of the transistor **142** in the Schmitt trigger circuit is less than the voltage at the emitter of the transistor, and the transistor **142** is in a non-conducting state. During operation, as the voltage at the base of the transistor **140** becomes increasingly negative, the transistor **140** remains in a conductive state until its base bias voltage becomes less than the potential on its emitter. When this occurs, the transisor **140** ceases conducting and the voltage at its collector rises sharply. This voltage rise is transferred to the base of the transistor **142** through the capacitor **148**, thus causing the transistor **142** to become conductive. Conduction through the transistor **142** is maintained by the increased base voltage now available through the resistor **146**. When the transistor **142** conducts, a negative signal appears across the resistor **154** in its collector circuit, which signal is differentiated by the resistor **156** and the capacitor **158** to apply a negative pulse through the diode **160** to the base of the transistor **162**.

The transistors **162**, **164** with their associated circuit elements comprise the monostable multivibrator previously mentioned in connection with the block diagram of FIG. 4. The base of the transistor **162** is so biased by current flow through the resistors **166**, **168** that the transistor **162** is in a conductive state. The transistor **164** is maintained in a non-conductive state because of the relatively low voltage transferred to its base through the resistor **180** from the collector of the transistor **162**. When a negative pulse is applied to the base of the transistor **162**, the transistor is momentarily driven to a non-conductive state and the voltage at its collector rises sharply. This positive rise is transferred to the base of the transistor **164** through the capacitor **182**, thus causing the transistor **164** to conduct and causing the voltage at its collector to drop sharply. This voltage drop is transferred to the base of the transistor **162** through the capacitor **176** to maintain the transistor **162** in a non-conductive state until the capacitor **176** is discharged by current flow through the resistor **168**. When the capacitor **176** has discharged, the transistor **162** is again biased to a conductive state, which in turn biases the transistor **164** to a non-conductive state. Thus, there is a single positive pulse at the collector of the transistor **162** each time the base of the transistor **140** in the Schmitt trigger is driven negative The time duration or width of the positive pulse is determined by the time constant of the resistor **168** and capacitor **176** in the capacitor discharge circuit.

The positive pulse occurring at the collector of the transistor **162** is transferred through the conventional buffer amplifier transistor **184** to the bases of the transistors **196**, **206**. The diode **192** connected between the emitter of the transistor **184** and the bases of the transistors **196**, **206** has a slight forward voltage drop that serves to reduce the voltage at the bases of the transistors **196**, **206** and insures that they will conduct only during a positive excursion of the voltage appearing at the collector of the transistor **162**. When the transistor **196** conducts in response to a positive pulse appearing on its base, a negative pulse appears at its collector. This negative pulse is applied to the capacitor **204** in the charge pump **94** connected to the input of the integrating amplifier **81**.

When the negative pulse from the collector of the transistor **196** appears on one side of the capacitor **204**, it is neutralized by current flowing from the integrating capacitor **86** through the diode **200**. When the voltage at the collector of the transistor **196** again rises to its original value at the termination of the input pulse to its base, the charge that has come from the integrating capacitor **86** is conducted to ground through the diode **202**. The movable arm of the potentiometer **198** is so adjusted that the charge required from the capacitor **86** to neutralize the negative pulse transmitted to the capacitor **204** is just sufficient to restore the output voltage from the integrating amplifier **81** to its initial value and reset the Schmitt trigger circuit.

The positive pulse from the collector of the transistor **162** and from the emitter of the transistor **184** is also applied to the base of the driver transistor **206**. The collector voltage of the transistor **206** and the emitter voltage of the transistor **208** are both obtained from the lead **212** which is connected to the generator load resistor **80** shown in FIG. 4. When a positive pulse is applied to the base of the transistor **206**, the transistor **206** conducts thus applying a negative voltage to the base of the transistor **208**. When the transistor **208** saturates, the voltage pulse appearing at its collector closely approximates the value of the voltage appearing across the generator load resistor **80**, because there is very little emitter-collector voltage drop across the transistor. These positive pulses appearing at the collector of the transistor **208** are applied to the charge pump circuits **102**, **104**.

The charge pump **102** comprises the capacitor **218** and the diodes **220**, **222**. When a positive output pulse appears on the collector of the transistor **208**, it places a positive charge on the upper plate of the capacitor **218**. Thus current flows through the diode **222** and the meter **100** to ground. At the termination of the positive output pulse from the transistor **208**, current flows from ground to the lower plate of the capacitor **218** through the diode **220**. The capacitor **224** serves to integrate or smooth the pulsating current applied to the meter. The charge transferred through the charge pump **102** is determined by the amplitudes of the pulses apearing at the collector of the transistor **208** and the pulse repetition rate of the pulses. Inasmuch as both of these quantities are proportional to the generator load voltage, the total charge transferred is proportional to their product (E_2) and thus is proportional to the power delivered by the generator to the load resistor.

The charge pump **104** comprises the capacitor **226**, and the diodes **228**, **230**. It operates in the same fashion as the charge pump **102** previously described, and functions to transfer to the integrating amplifier **105** a charge that is proportional to the power delivered by the generator **48** to its load resistor **80** (FIG. 4).

The integrating amplifier **105** comprises the resistor **107**, the operational amplifier **106**, and the feedback capacitor **108**. The transistor **140′**, **142′** form a Schmitt trigger circuit similar to that formed by the transistors **140**, **142** previously described, and the transistors **162′**, **164′** form a monostable multivibrator similar to that formed by the transistors **162**, **164** previously described. The transistor **184′** comprises the buffer amplifier **112**, and the transistor **196′** is a part of the charge pump **114** connected to the input of the integrating amplifier **105**. The buffer amplifier **184′** provides on its emitter a second series of pulses, each pulse of which represents a unit quantity of power delivered. By proper adjustment of the various circuit constants, this unit quantity of power delivered can be made equal to 0.1 of a food calorie or any other desired multiple of a food calorie.

The principal difference between the circuitry shown in the upper half of FIG. 5 and that shown in the lower half of the figure lies in the output stage comprising an NPN transistor **234** and a PNP transistor **236**. The base of the transistor **234** receives positive pulses from the emitter of the transistor **184'**. The transistor **234** acts as a driver transistor and conducts heavily in response to the positive pulses applied to its base. This results in negative pulses being applied from its collector to the base of the power transistor **236**. The actuating coil for the counter **118** is connected in the collector circuit of the power transistor **236**, and hence is energized by each positive pulse transmitted to the output circuitry from the buffer transistor **184'**. Thus, the counter **118** is caused to register each pulse received to indicate a cumulative total of multiples of food calories expended since the counter **118** was reset to its zero or starting position.

It is now apparent that apparatus embodying the invention provides an accurate indication of the rate at which food calories are being expended by a user of the apparatus, as well as an accurate indication of the cumulative total of food calories expended by the user since the start of an exercise period. Although an embodiment of the invention has been shown and described in detail, it is apparent that many changes and modifications may be made by one skilled in the art without departing from the true spirit and scope of the invention.

What is claimed is:

1. Apparatus for indicating energy expended and work done by an individual comprising:

(a) electrical generator means to be mechanically driven by said individual for providing a generator output voltage;

(b) first means for receiving said generator output voltage and providing a first series of pulses having a repetition rate substantially proportional to amplitude of said generator output voltage and pulse amplitudes proportional to said amplitude of said generator output voltage;

(c) second means for receiving said first series of pulses and providing a second series of pulses having a second repetition rate substantially proportional to a square of said generator output voltage amplitude; and

(d) counter means for receiving said series of second pulses and providing an indication of number of pulses received.

2. The apparatus of claim **1**, further including indicator means for providing an indication of said first repetition rate.

3. The apparatus of claim **1**, wherein said counter means is calibrated in terms of cumulative food calories expended by said individual.

4. The apparatus of claim **2**, wherein said indicator means is calibrated in terms of a rate at which food calories are being expended by said individual.

5. The apparatus of claim **2**, wherein said indicator means is calibrated in terms of a rate at which food calories are being expended by said individual and said counter means is calibrated in terms of cumulative food calories expended by said individual.

6. The apparatus of claim **1**, wherein said first means comprises:

(i) first integrating means for receiving said generator output voltage and producing a first output signal whose amplitude is proportional to a time integral of said generator output voltage;

(ii) first pulse generator means for receiving said first output signal and producing a first pulse output signal of predetermined width when said amplitude of said first output signal reaches a predetermined level;

(iii) first cycling means for re-cycling said first integrating means in response to each said first pulse output signal, and

(iv) amplitude gate means for receiving said first pulse output signal and said generator output voltage and producing said first series of pulses.

7. The apparatus of claim **1**, wherein said second means comprises:

(i) second integrating means for receiving said first series of pulses and producing a second output signal whose amplitude is proportional to a time integral of said first series of pulses;

(ii) second pulse generator means for receiving said second output signal and producing a second pulse output signal of predetermined width when said amplitude of said second output signal reaches a predetermined level; and

(iii) second cycling means for recycling said second integrating means in response to each said second pulse output signal for producing said second series of pulses.

8. The apparatus of claim **1**, wherein said first means comprises:

(i) first integrating means for receiving said generator output voltage and producing a first output signal whose amplitude is proportional to a time integral of said generator output voltage;

(ii) first pulse generator means for receiving said first output signal and producing a first pulse output signal of predetermined width when said amplitude of said first output signal reaches a predetermined level;

(iii) first cycling means for recycling said first integrating means in response to each said first pulse output signal, and

(iv) amplitude gate means for receiving said first pulse output signal and said generator output voltage and producing said first series of pulses;

and said second means comprises:

(i) second integrating means for receiving said first series of pulses and producing a second output signal whose amplitude is proportional to a time integral of said first series of pulses;

(ii) second pulse generator means for receiving said second output signal and producing a second pulse output signal of predetermined width when said amplitude of said second output signal reaches a predetermined level; and

(iii) second cycling means for recycling said second integrating means in response to each said second pulse output signal for producing said second series of pulses.

9. The apparatus of claim **6**, wherein said first pulse generator means comprises a Schmitt trigger circuit and a monostable multivibrator connected in series.

10. The apparatus of claim **7**, wherein said second pulse generator means comprises a Schmitt trigger circuit and a monostable multivibrator connected in series.

11. The apparatus of claim **6**, further including indicator means for providing an indication of said first repetition rate.

12. The apparatus of claim **11**, wherein said indicator is calibrated in terms of a rate at which food calories are being expended by said individual.

13. The apparatus of claim **11**, wherein said indicator means is calibrated in terms of a rate at which food calories are being expended by said individual and said counter means is calibrated in terms of cumulative food calories expended by said individual.

14. The apparatus of claim **7**, further including indicator means for providing an indication of said first repetition rate.

15. The apparatus of claim **14**, wherein said indicator means is calibrated in terms of a rate at which food calories are being expended by said individual.

16. The apparatus of claim 14, wherein said indicator means is calibrated in terms of a rate at which food calories are being expended by said individual and said counter means is calibrated in terms of cumulative food calories expended by said individual.

17. The apparatus of claim 8, further including indicator means for providing an indication of said first repetition rate.

18. The apparatus of claim 17, wherein said indicator means is calibrated in terms of a rate at which food calories are being expended by said individual and said counter means is calibrated in terms of cumulative food calories expended by said individual.

19. Apparatus for converting an input voltage developed across an impedance to power dissipated in terms of watt-seconds comprising:

(a) first integrating means for receiving said input voltage and producing a first output signal whose amplitude is proportional to a time integral of said input voltage;

(b) first pulse generator means for receiving said first output signal and producing a first pulse output signal of predetermined width when said amplitude of said first output signal reaches a predetermined level;

(c) first cycling means for recycling said first integrating means in response to each said first pulse output signal;

(d) amplitude gate means for receiving said first pulse output signal and said generator output voltage and producing a first series of pulses having a first repetition rate substantially proportional to amplitude of said input voltage and pulse amplitudes substantially proportional to said amplitude of said input voltage;

(e) second integrating means for receiving said first series of pulses and producing a second output signal whose amplitude is proportional to a time integral of said first series of pulses;

(f) second pulse generator means for receiving said second output signal and producing a second pulse output signal of predetermined width when said amplitude of said second output signal reaches a predetermined level; and

(g) second cycling means for recycling said second integrating means in response to each said second pulse output signal for producing a second series of pulses having a second repetition rate substantially proportional to a square of said input voltage amplitude.

20. The apparatus of claim 19, further including counter means for receiving said second series of pulses and providing an indication of number of pulses received.

21. The apparatus of claim 19, wherein said first pulse generator means comprises a Schmitt trigger circuit and a monostable multivibrator connected in series.

22. The apparatus of claim 19, wherein said second pulse generator means comprises a Schmitt trigger circuit and a monostable multivibrator connected in series.

23. The apparatus of claim 19, further including indicator means for providing an indication of said first repetition rate.

24. The apparatus of claim 20, further including indicator means for providing an indication of said first repetition rate.

25. Apparatus for indicating energy expended by an individual comprising:

(a) electrical generator means to be mechanically driven by said individual for providing a generator output voltage;

(b) means responsive to said generator output voltage for providing a series of pulses having a repetition rate substantially proportional to amplitude of said generator output voltage comprising:

(i) integrating means responsive to said generator output voltage producing an output signal whose amplitude is proportional to a time integral of said generator output voltage;

(ii) pulse generator means responsive to said output signal for producing a pulse output signal of predetermined width when said amplitude of said output signal reaches a predetermined level;

(iii) cycling means for re-cycling said integrating means in response to each said pulse output signal; and

(iv) amplitude gate means responsive to said pulse output signal and to said generator output voltage for producing said series of pulses;

(c) indicator means responsive to said series of pulses for providing an indication of said repetition rate.

26. The apparatus of claim 25, wherein said pulse generator means comprises a Schmitt trigger circuit and a monostable multivibrator connected in series.

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RICHARD C. QUEISSER, Primary Examiner

E. J. KOCH, Assistant Examiner

U.S. Cl. X.R.

235—193.5; 324—142

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,511,097 Dated May 12, 1970

Inventor(s) Gilbert Corwin

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 47, "votlage" should be ---voltage---.

Column 5, line 72, an unrelated phrase has been inserted.

Column 6, line 11, "collecor" should be ---collector---

SIGNED AND SEALED AUG 25 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334

United States Patent [19]

Oosthuizen et al.

[11] **Patent Number: 4,842,274**

[45] **Date of Patent: Jun. 27, 1989**

[54] **EXERCISE APPARATUS**

[76] Inventors: **Albertus D. Oosthuizen; Janusz K. Buczkowski; Teresa Buczkowska; Joanne A. Buczkowska,** all of 48 Hamilton Street, Lane Cover, Australia, 2066

[21] Appl. No.: **145,742**

[22] Filed: **Jan. 19, 1988**

Related U.S. Application Data

[63] Continuation of Ser. No. 835,115, filed as PCT AU85/00129 on Jun. 14, 1985, published as WO86/00024 on Jun 3, 1986, abandoned.

[30] **Foreign Application Priority Data**

Jun. 14, 1984 [AU] Australia PG5504

[51] **Int. Cl.**[4] **A63B 21/24**

[52] **U.S. Cl.** **272/129**; 272/125

[58] **Field of Search** 272/72, 129, 130, 125

[56] **References Cited**

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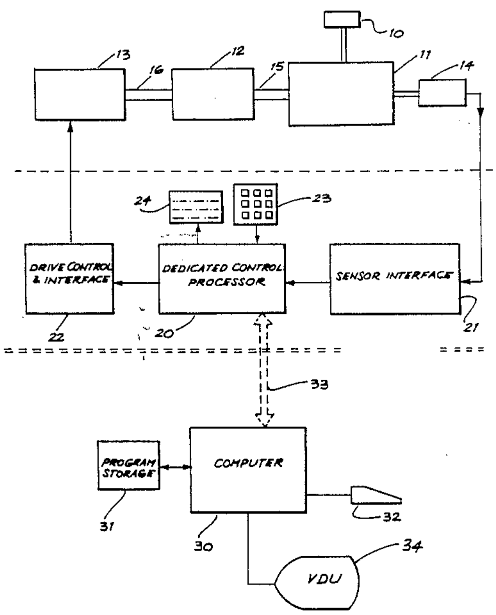
Primary Examiner—Leo P. Picard
Attorney, Agent, or Firm—Armstrong, Nikaido, Marmelstein & Kubovcik

[57] **ABSTRACT**

An exercise apparatus comprises a variable speed rotary driving device which generates a torque having a magnitude dependent on its speed of rotation; an adjustable speed control which controls the speed of rotation of the rotary driving device; an exercise element, mainpulable by a user; and a torque transmission which transmits torque from the rotary driving device to the exercise element so as to resist manipulation of the exercise element and to allow for lost motion between the rotary driving device and the exercise element. The torque transmission transmits torque, from the rotary driving device to the exercise element, of a magnitude substantially independently of the motion of the exercise element and dependent upon the speed of rotation of the rotary driving device.

23 Claims, 10 Drawing Sheets



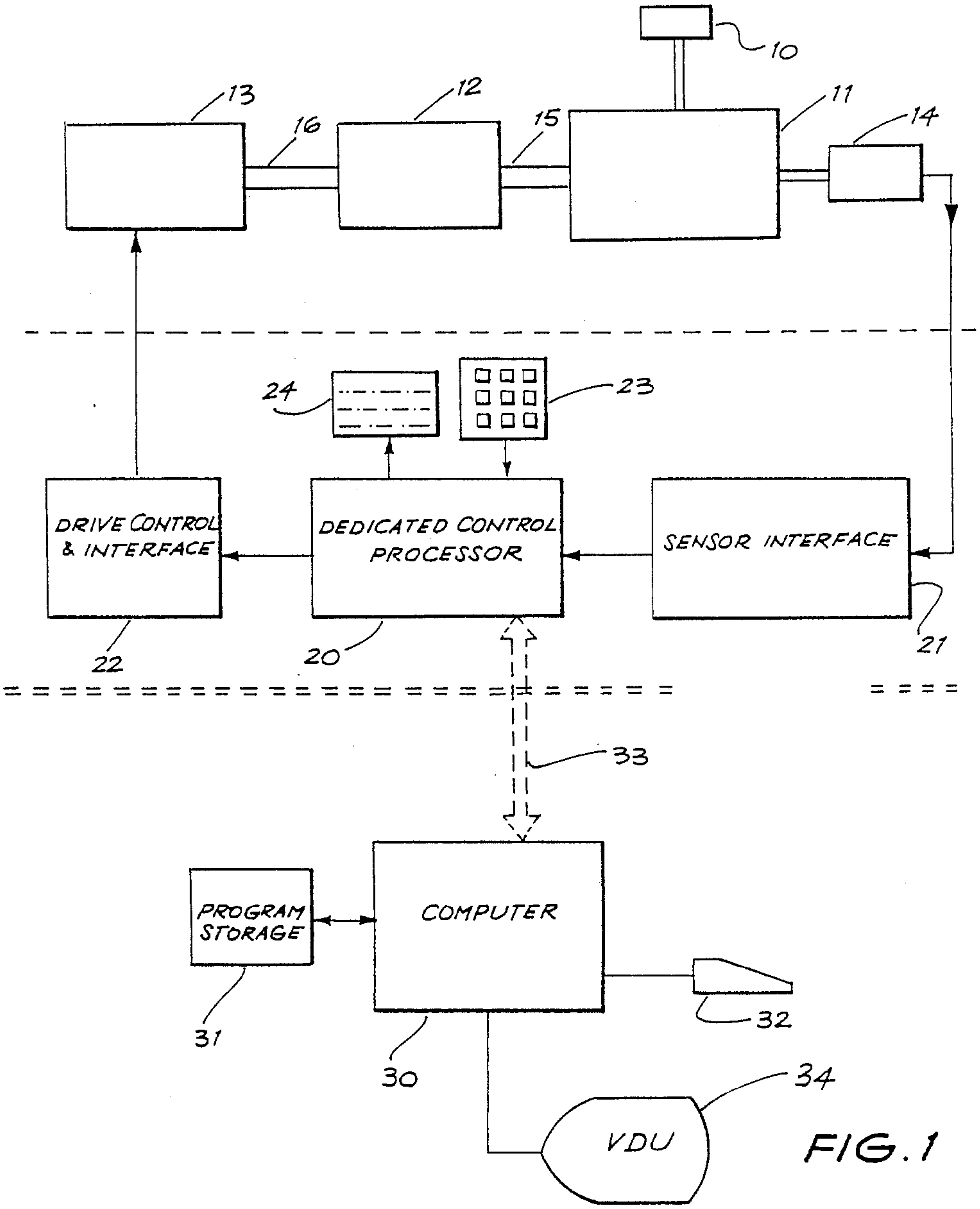

10
13
12
11
14
16
15
24
23
DRIVE CONTROL & INTERFACE
DEDICATED CONTROL PROCESSOR
SENSOR INTERFACE
22
20
21
33
PROGRAM STORAGE
COMPUTER
31
30
32
34
VDU

FIG. 1

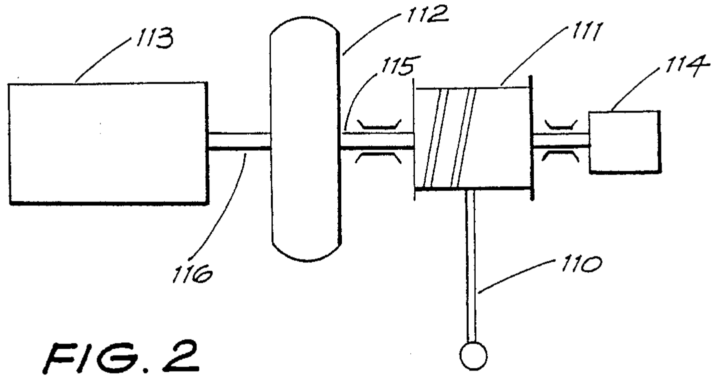


FIG. 2

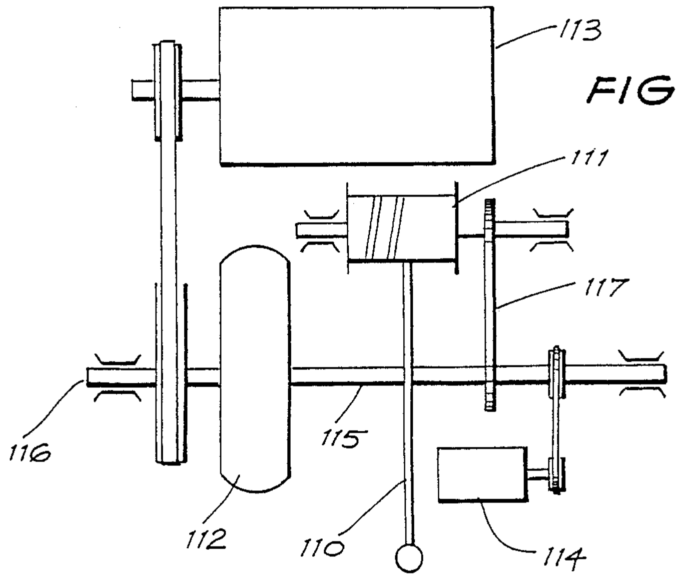


FIG. 3

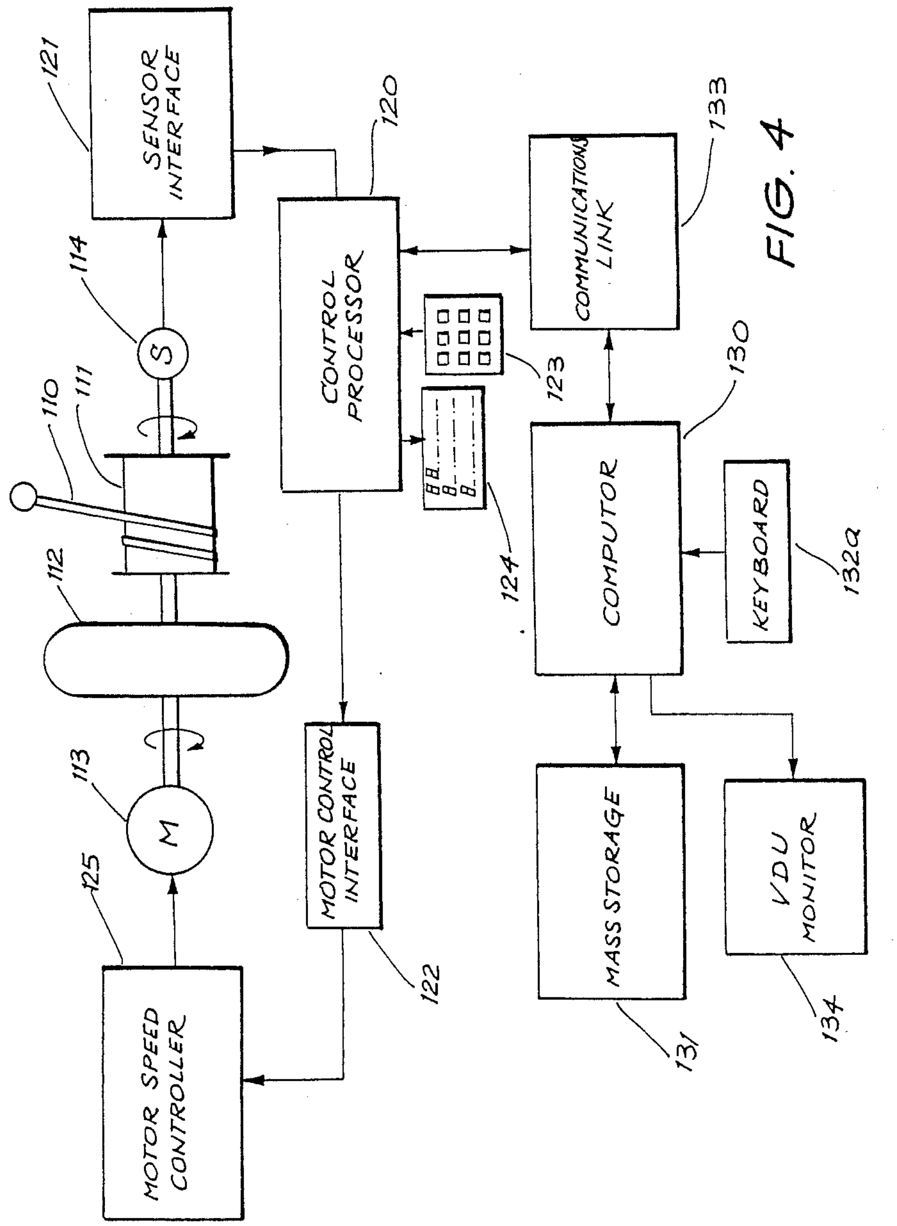

SENSOR INTERFACE
121
120
CONTROL PROCESSOR
COMMUNICATIONS LINK
133
114
S
110
111
123
124
130
COMPUTOR
KEYBOARD
132a
112
113
M
125
MOTOR CONTROL INTERFACE
122
MASS STORAGE
131
VDU MONITOR
134
MOTOR SPEED CONTROLLER

FIG. 4

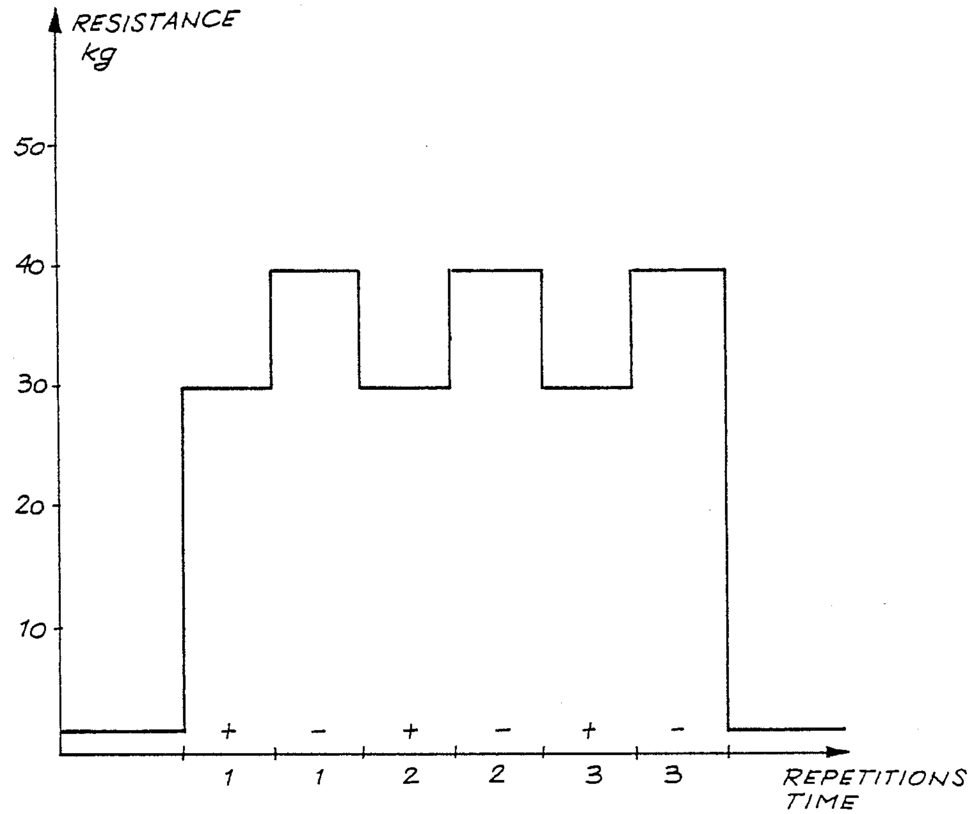


FIG. 5

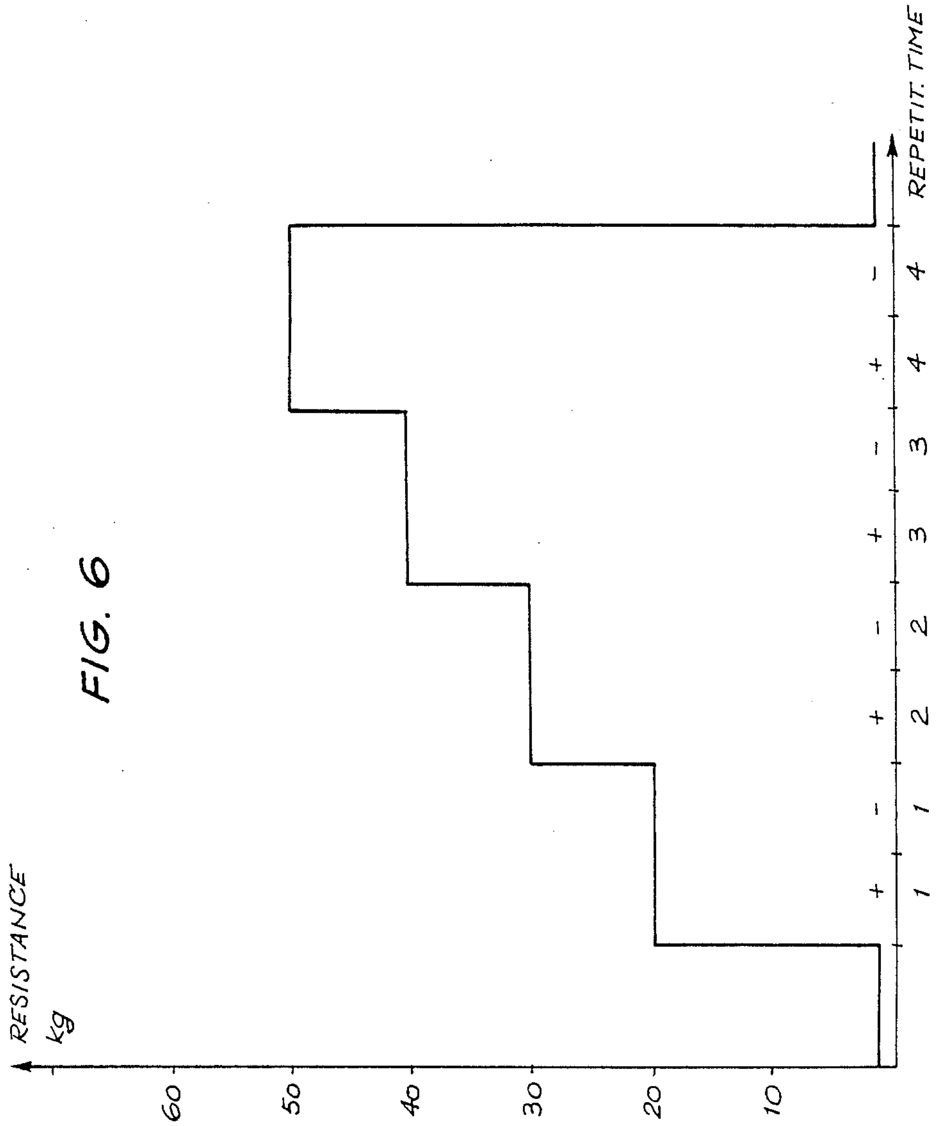


FIG. 6

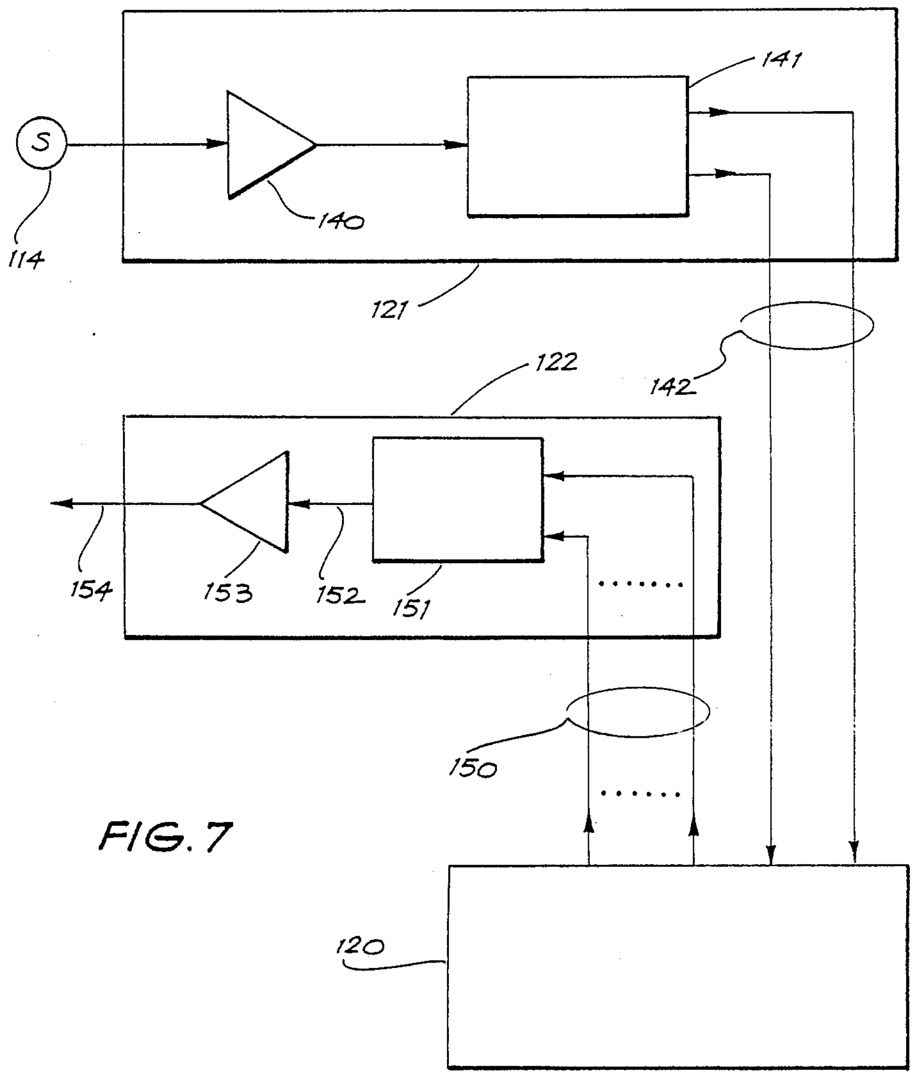


FIG. 7

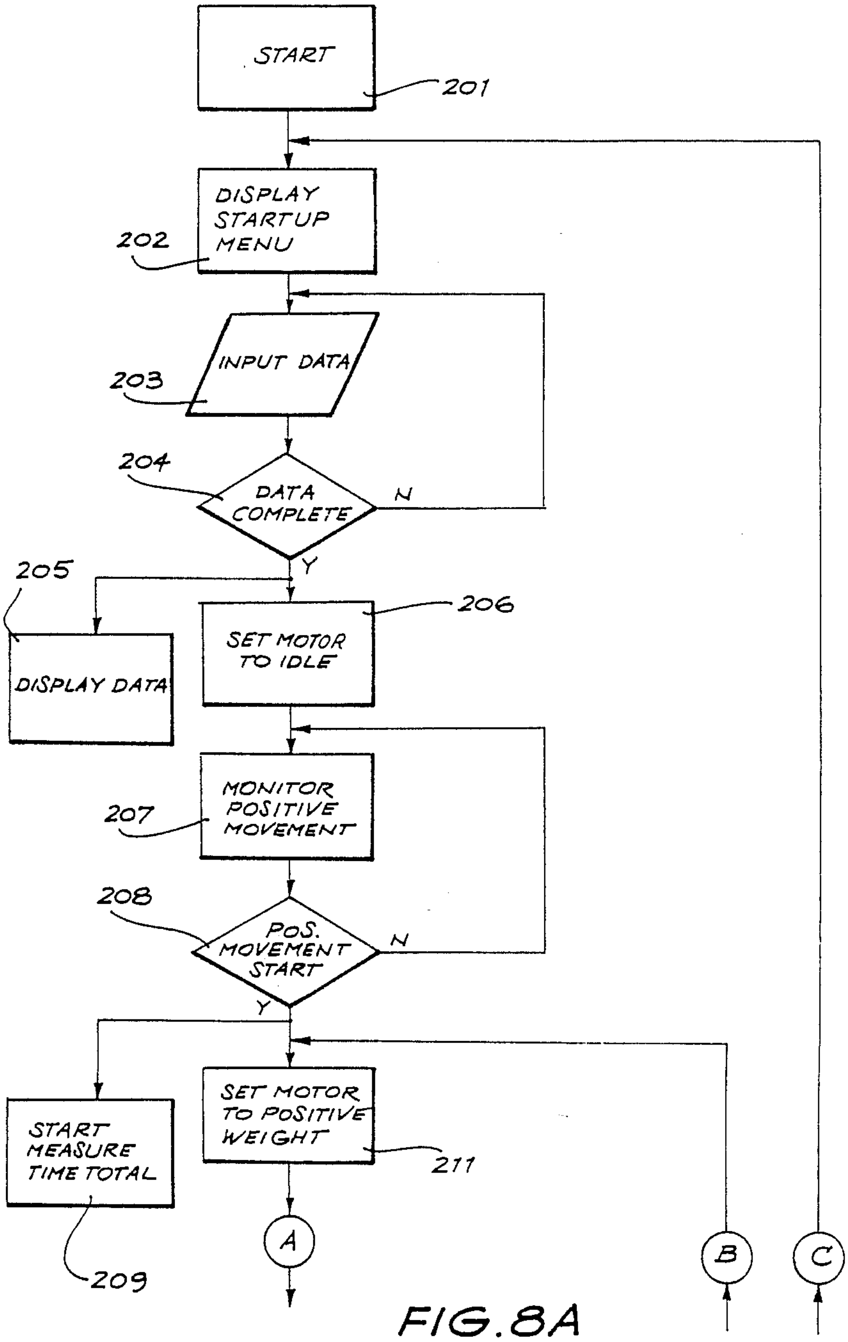

START
201
DISPLAY STARTUP MENU
202
INPUT DATA
203
204
DATA COMPLETE
N
Y
205
DISPLAY DATA
SET MOTOR TO IDLE
206
MONITOR POSITIVE MOVEMENT
207
208
POS. MOVEMENT START
N
Y
START MEASURE TIME TOTAL
209
SET MOTOR TO POSITIVE WEIGHT
211
A
B
C

FIG. 8A

APPENDIX Y

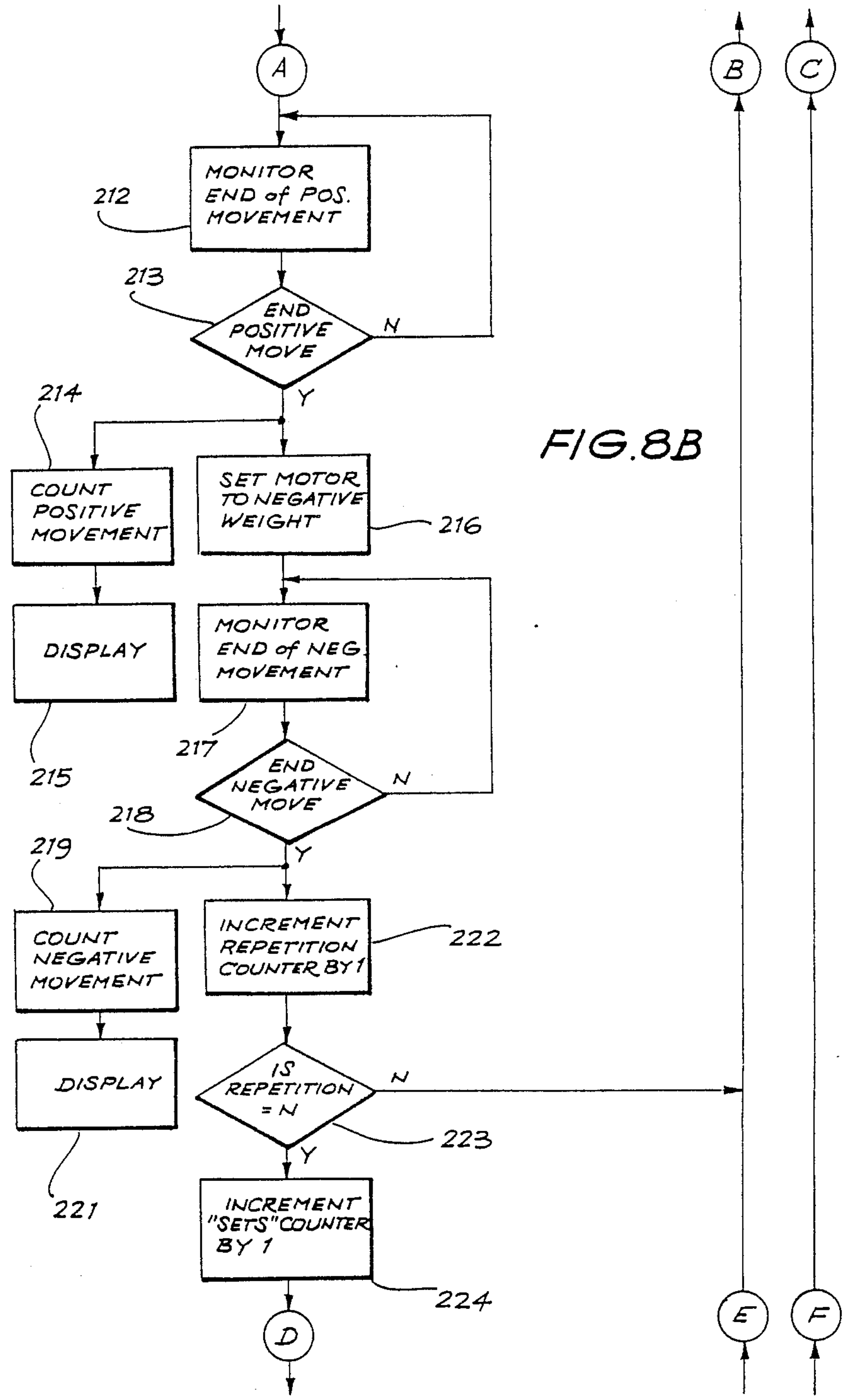


FIG. 8B

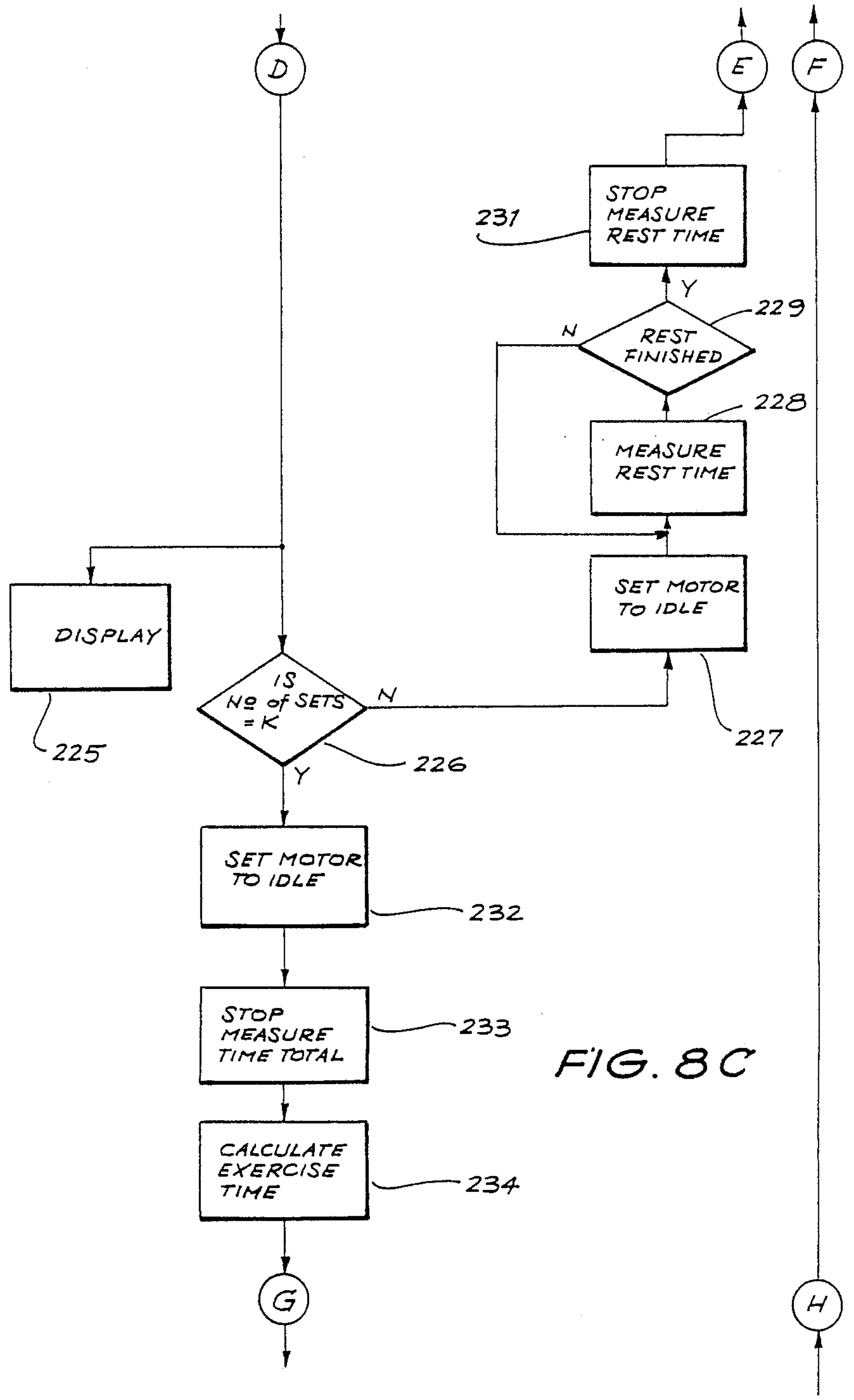

D
E
F
STOP MEASURE REST TIME
231
Y
229
N
REST FINISHED
228
MEASURE REST TIME
SET MOTOR TO IDLE
DISPLAY
IS No of SETS = K
N
225
226
Y
227
SET MOTOR TO IDLE
232
STOP MEASURE TIME TOTAL
233
CALCULATE EXERCISE TIME
234
G
H

FIG. 8C

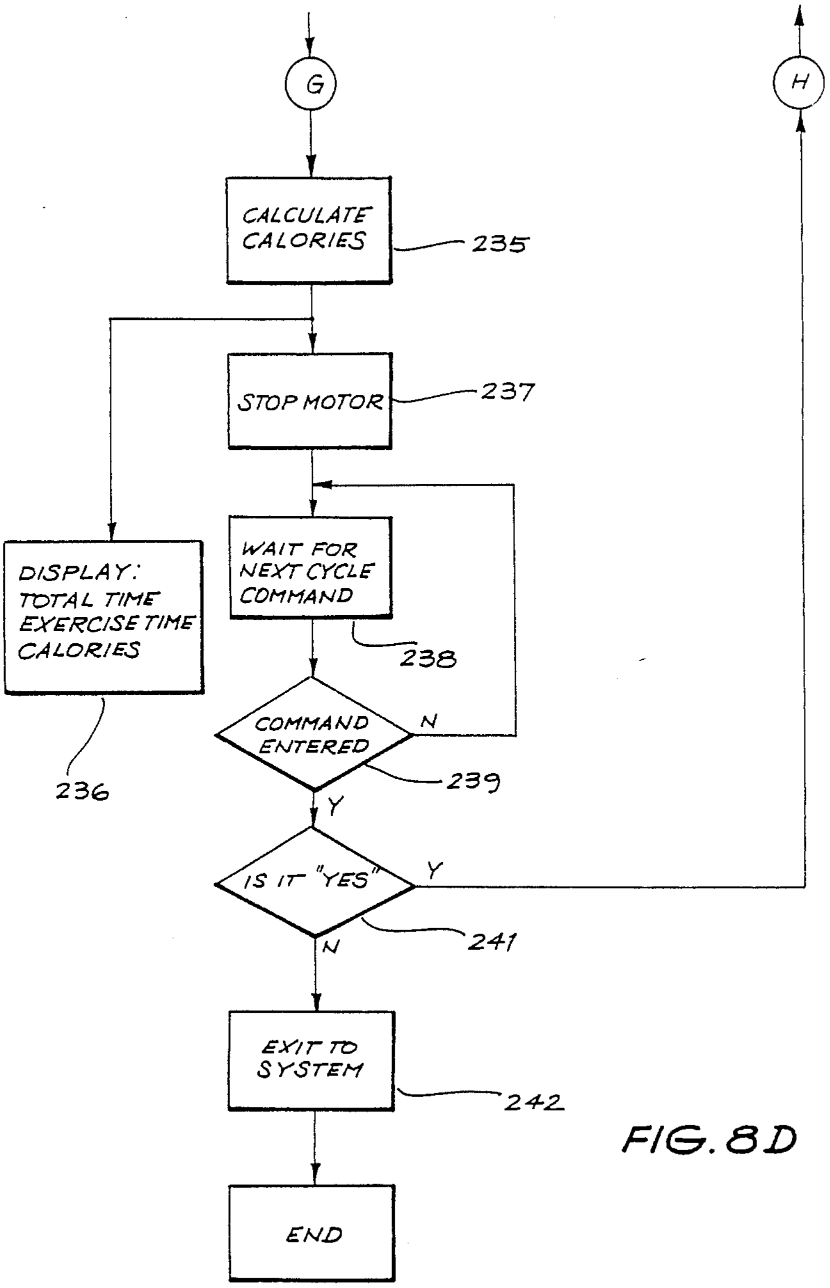

G
H
CALCULATE CALORIES
235
STOP MOTOR
237
WAIT FOR NEXT CYCLE COMMAND
238
DISPLAY: TOTAL TIME EXERCISE TIME CALORIES
236
COMMAND ENTERED
N
239
Y
IS IT "YES"
Y
241
N
EXIT TO SYSTEM
242
END

FIG. 8D

EXERCISE APPARATUS

This is a continuation of Ser. No. 835,115, filed as pct Aug 5/00129 on Jul. 14, 1985, published as W086/00024 on Jan. 3, 1986, now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates to an exercise apparatus and more particularly, but not exclusively, to a programmeable exercise apparatus.

Resistance training is used for strength, muscular endurance and aerobics, speed and power, muscle toning and body-building. It is generally accepted that when training to improve any of the above, the exercise regimen must be based on the overload principle, i.e. the muscles of the body must be forced to work against greater resistance than that to which they are normally accustomed. The resistance may be isometric, isokinetic (sometimes called variable) or isotonic depending on the purpose of exercise.

Resistance training is typically performed in groups of repetitive exercise movements, wherein each group of movements is called a set and each repetitive movement is called a repetition. Within a single exercise repetition resistance may be applied to concentric (positive) movement and/or eccentric (negative) movement. The magnitude of the concentric and eccentric movements may be varied independently. For example, it has been found that in certain types of exercise, significant strength increases are obtained if the eccentric resistance is increased over the concentric resistance.

Within an exercise set the resistance may be varied from repetition to repetition. For example, the resistance may be progressively increased over the first repetitions and then decreased over the later repetitions. This is sometimes referred to as pyramiding.

Many combinations of movements and resistive forces are possible and the best effect is achieved when the combination is tailored to the application, with applications such as professional body building, rehabilitation and sport or leisure exercises having differing requirements. For optimum results the exercise apparatus should be set for each particular type of exercise activity and in order to minimize the cost, one piece of equipment should cover the widest possible field of applications.

An important part of any exercise programme is the ability to monitor its progress by way of suitable indications related to duration of the exercise, number of movements executed, energy expended and other useful information. Availability of such feedback information not only enables the progress of the exercise programme to be monitored and controlled simply, but may also be a positive encouragement to the user.

Exercise apparatus currently available use a variety of principles to achieve resistance against which the user must exert himself. Two most common groups of equipment available on the market make use of weightstacks and free weights. Used also in various specific designs are: pneumatic cylinders, hydraulic cylinders, friction devices, electromagnetic brakes, resilient bands and/or springs etc. used singly or in various combinations.

Probably the most popular principle is that which makes use of a weightstack in conjunction with cables, pulleys and levers in order to provide resistance to an operator's muscular movements and efforts.

In equipment making use of a weightstack, it is an advantage that the stack will apply a given force against which the operator must exert himself, almost independently of movement. However, it is a disadvantage of the weightstack that there is an inertia to be overcome, thereby increasing the load on the user when upward weightstack movement is first initiated, or if the weights are accelerated. The resilient bands and springs employed as alternatives to the weightstaks have the disadvantage that the force applied to the operator varies in accordance with the elongation of the resilient bands or springs. It is a disadvantage of the other devices, such as pneumatic cylinders, used as alternatives to weightstacks that the resisting force encountered by the operator depends on the speed at which they are operated, as opposed to the almost constant gravitational force provided by the weightstack.

A substantial disadvantage usually associated with each of the above methods of providing resistance is that they do not provide any feedback information to the user about the progress of the exercise programme. Also, it is not known in equipment using the above methods to provide a pre-programmed varying combination of resistances during the course of exercise while at the same time providing one piece of equipment which covers a wide range of applications. Rather, if any change in resistance is desired, the exercise must be stopped temporarily and suitable adjustments made, after which the exercise programme may be resumed. Such a disruption to the continuity of the exercise is most undesirable. As an alternative, a second person may be used to manipulate the resistance of the exercise apparatus, but this method requires constant presence of the second person and is prone to errors in adjustment. Many attempts have been made to design exercise apparatus with some degree of programmability but to date it is not known for such a piece of apparatus to cover a complete range of applications, while at the same time providing features closely approximating those of the weightstack.

Numerous patents have been issued in the past, which disclose various parts or equipment within the exercise apparatus field. U.S. Pat. No. 3,998,100 to Pizatella et al covers the use of computer control to vary and regulate only the operating speed of the exercising device. U.S. Pat. No. 3,848,467 to Flavell refers to the partially programmed exercising machine, but the programmed control covered only the end points of the exercising strokes. Many other specifications disclose the control of speed of movement, examples of which are U.S. Pat. Nos. 3,465,592 and 3,784,194 to J. J. Perrine for mechanical and hydraulic devices used for speed control. Centrifugal control devices are described in the U.S. Pat. Nos. 3,640,530 and 3,896,672 to Henson et al. An electronic and electromechanical servo system is shown in the Wilson U.S. Pat. No. 3,902,480 and Flavell U.S. Pat. Nos. 3,848,467 and 3,869,121. U.S. Pat. No. 4,354,676 to G. B. Ariel shows a combination machine using a hydraulic cylinder as a source of resistance combined with computerised control and displays. This design, however, is limited to linear movements imposed on it by the use of the hydraulic cylinder/piston combination.

It is the object of the present invention to overcome or substantially ameliorate one or all of the above disadvantages and/or shortcomings.

SUMMARY OF THE INVENTION

The present invention consists in an exercise apparatus comprising a driving device, an exercise element to be directly or indirectly manipulated by a user and driven by the driving device, and torque transmitting means coupling the said driving device and exercise element so as to allow for lost motion therebetween.

In a preferred form of the present invention, there is provided an exercise apparatus including an electric motor, a hydraulic clutch driven by said motor, and a drum rotatably driven by the clutch, the drum receiving a flexible cable which is pulled by the user when working against the torque transmitted via said clutch from the motor during an exercise programme. The effective torque developed by said motor is proportional to the speed of revolution of the motor, this speed being controlled by a suitable motor speed controller. Thus, by varying the speed of the motor the torque developed will vary and so will the resistance presented to a user who pulls on the cable. While the speed of the driving device is high relative to the speed of the drum, such that the speed differential is relatively constant, the torque developed and in turn the resistance presented to the user will remain substantially constant. In this mode of operation the apparatus approximates very closely the behaviour of a weightstack.

The motor speed controller can in turn be regulated by a computer programme which holds all relevant information concerning particular exercise to be executed. Further, as the resistance can be controlled by the computer programme, by way of the speed of the motor and the transmitted torque, it is possible to programme any value of the resistance for each movement in the positive or negative direction. It is also a simple matter to programme the computer to provide a gradually increasing or decreasing resistance, or any other desirable resistance profile.

To provide the user with information relevant to the exercise performed, a comprehensive display is provided containing information on exercise progress, elapsed time, expended energy, etc. Data pertinent to the exercise performed is collected by the computer from information existing in the system and also from the sensor coupled to the drum. This sensor detects the drum movement and transmits signals representing positive and negative movements to the computer. Installed internally in the computer is an electronic clock which provides time pulses used by the computer to measure duration of a specific exercise or part of it. Data collected by the computer during the course of exercise may be reviewed and discarded or it may be stored for future reference.

The basic resistance controlling mechanism of the present invention can be used in a variety of frames which are commonly used in the field of exercising, or it may be mounted in a specially designed, multipurpose frame.

The preferred embodiments of the present invention provides a programmeable exercise apparatus, allowing the user to programme a wide range of exercise patterns including patterns which make use of isotonic, isometric and isokinetic resistance and wherein the resistnce associated with positive (concentric) and negative (eccentric) movements of an exercise repetition can be determined independently, as may the resistances associated with each repetition of an exercise set. The preferred embodiment also provides comprehensive feedback of the user's performance and the progress of the exercise, and the apparatus closely approximates the behaviour of equipment based upon a weightstack.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIG. 1 illustrates a simplified block diagram of an embodiment of the invention;

FIG. 2 schematically illustrates a first embodiment of the mechanical component of an exercise machine made in accordance with the present invention;

FIG. 3 schematically illustrates a second embodiment of the mechanical component of an exercise machine made in accordance with the present invention;

FIG. 4 illustrates a block functional diagram of the preferred embodiment of the invention;

FIG. 5 graphically illustrates an example of resistance variation for positive (concentric) and negative (eccentric) movement in a simple exercise set;

FIG. 6 graphically illustrates an example of pyramiding in an exercise set, wherein resistance is varied from repetition to repetition;

FIG. 7 illustrates a block diagram of the motor control interface and sensor interface of the preferred embodiment; and

FIGS. 8A, B, C and D illustrate a flowchart of an example of an exercise control programme for the embodiment of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A programmeable exercise apparatus constructed in accordance with one embodiment of the present invention is shown in the diagram of FIG. 1. In this drawing there is an exercise element which is operated by an operator in any appropriate manner. In general, a user interface **10** is provided to enable operation of the exercise element **11** which is driven by a coupling device, preferably an hydraulic clutch **12**. The coupling device **12** is in turn driven by a driving device **13** which is preferably an electric motor but which might also be a pneumatically or hydraulically driven device. Preferably the coupling device **12** operates so that the torque applied to the exercise element **11** via shaft **15** is reasonably constant for a given speed of the drive. Also the coupling device **12** is constructed so that even if the exercise element **11** is halted, the drive **13** and the coupling device input shaft **16** would continue to rotate. By controlling the speed of the drive **13**, the torque applied to the exercise element **11** can be determined using the transfer characteristic of the coupling device **12** and therefore, by suitably controlling the operating conditions of the drive **13**, an exercise programme can be produced which is designed to meet specific requirements of the particular user, that is to say, by increasing the speed of the drive **13**, a greater torque is applied to the exercise element **11**, thereby requiring a greater effort on the part of the user. The use of the electric drive **13** has the advantage in this application that it is easily controlled either remotely or locally.

The exercise apparatus is provided with a sensor **14** which produces a signal representative of the speed and/or direction of movement of the exercise element **11**.

The sensor output signal is transmitted to a dedicated control processor **20**, such as a "single chip" microprocessor, via a sensor interface **21**, thereby allowing the control processor to monitor the set of exercises being performed and to control the drive device **13**, via a drive control and interface **22**, to vary the resistance experienced by the operator in accordance with a predetermined exercise programme which has been entered into the processor **20**. The processor **20** also processes the signal received from the sensor **14** to generate information relating to the number of exercise repetitions, direction and speed of movement, etc. Feedback from sensor **14** is used by the processor **20** to produce a variety of information relevant to the exercise performed, this information being displayed to the user.

A keypad **23** is connected to the control processor **20** to enable entry of control parameters defining a set of exercises, while a display device **24**, also connected to the processor **20**, enables display of the data as it is entered, in order that it might be verified. The display device is also used to display information relating to the rate at which exercises are being performed, as a form of feedback to the user.

A predefined set of exercises can also be loaded into the control processor **20** from a separate, and possibly remote, computer **30** via a suitable interface and data communications link **33**. In this way, the parameters for a large number of individual sets of exercises may be defined and stored in a storage device **31** associated with the computer **30**, and recalled and loaded into the control processor **20** at will. The computer **30** would typically be a personal computer and the storage device **31** would typically be a disk drive or tape recorder, capable of storing digital data. Control of the computer **30** is via a Keyboard **32** through which new exercise parameters may be entered and existing parameters altered. The computer **30** can also be used to store data relating to a user's performance for future reference and comparison.

It will be obvious to persons skilled in the art that many types of electric motors may be used as the drive device **13** to drive the coupling device **12**. In the present embodiment of the invention the drive device is an AC induction motor.

Referring to FIGS. **2** and **3**, in the illustrated embodiments of the invention, the coupling device is a fluid type coupling commonly referred to as a hydraulic clutch **112**. The torque transmitted by the clutch **112** is proportional to the speed of revolution of the driving shaft **116** and it allows the output shaft **115** to stop while the driving shaft **116** is still rotating, without any damage to the equipment. The physical size of the clutch **112** will depend upon the desired range of torque to be transmitted, while the internal design of the clutch is typical and well known to those skilled in mechanical engineering. The clutch included in the present embodiment of the invention uses a constant level of fluid inside the clutch, however, an alternative is possible in which a hydraulic clutch with variable fluid level may be used.

In the embodiments of FIGS. **2** and **3**, the exercise element is a drum **111** on which a flexible rope or cable **110** is wound, one end of the cable being attached to the drum **111** and the other being pulled directly by the operator or being connected to a further interface mechanism such as a set of levers and handlebars. It will be recognised, however, that a set of levers could equally be connected directly to the output shaft of the clutch **112**.

The rotation of the shaft **115** with the drum **111** on which the rope **110** is wound is monitored by the sensor **114** coupled directly to the shaft or alternatively via a chain drive, toothed belt, meshing gears or other suitable means of transmission **117**. In these embodiments, the sensor **114** is a DC generator which transmits a signal to the control interface circuitry via connecting wires. The polarity of the voltage generated by the sensor **114** depends upon the direction of shaft rotation caused by the motion of the rope **110** which is pulled and released by the user, the generated voltage being present at the output of the generator only during shaft rotation (rope **110** movement), while the magnitude of the voltage generated is proportional to the speed of shaft rotation. Those skilled in the art will recognise that many other types of sensors, or combinations of sensors, may be used to transmit the relevant shaft rotation data, e.g. bidirectional incremental encoders, binary shaft position encoders (optical or mechanical), AC tachometer generators, etc. may be used with only slight modification to the control interface circuitry but without affecting the main principle of operation of the present invention. Operation of the motor **113** and thus of the rest of the apparatus is controlled by programme stored in the control processor **20**. The programme running in the control processor **20** will receive from the user suitable instructions concerning the type of the exercise to be performed, the desired resistance, the number of repetitions, etc. and it will control the speed of the motor **113** accordingly, at the same time receiving information from the sensor **114** as to the progress of the exercise.

All data received is constantly processed to provide parameters which are presented to the user on a suitable display device (LED, LCD, etc.) **24** (refer to FIG. **1**) or alternatively the parameters may be presented on a video screen or VDU display **34** associated with the computer **30**. It will be apparent to those skilled in the art that any computer may be used as the control processor **20** which directly controls the operation of the apparatus, and examples of suitable types of processor are a single board microcomputer, a personal microcomputer, a minicomputer or a single chip microprocessor with inbuilt RAM and EPROM. However, with reference to FIG. **4**, the control processor **120** will preferably be a dedicated single board microcomputer which makes use of a single chip microprocessor. In the preferred embodiment, the single board microcomputer will include provision for connection to a communications link **133** whereby it can be programmed from a remote computer **130** such as a personal computer or mini computer system.

The complete operation of the exercise apparatus in the preferred embodiment of the present invention will now be described with reference to the block functional diagram in FIG. **4**. To begin, the user must enter into the control processor **120** details relating to the exercise set which the user wishes to perform. This information may be entered through the dedicated keypad **123** according to an exercise pattern held in an EPROM associated with the control processor **120**, as one of a group of predefined basic exercise sets. Alternatively, the desired exercise set may be prerecorded on a mass storage medium such as tape or disk associated with a remote computer **130** and loaded into the control processor **120** via the communications link **133**. Details of the exercise data entered into the control processor **120** can be presented on the dedicated display **124**, or when the computer **130** is connected, the same data may be presented on a VDU display **134** associated with the remote computer **130**, or it may be displayed on home television equipped with a suitable adaptor.

After receiving the complete set of information required to control the exercise set, the control processor **120** displays a prompt indicating its readiness for use. At this stage the user may press the "GO" button (not shown) and will position himself in the place and pose suitable for the exercise to be performed. After short delay, designed to allow the user to move into proper position, the control processor **120** transmits an initiating signal to the motor control interface **122**. The motor control interface **122**, upon receipt of the initiating signal, applies power to the electric motor **113** just sufficient for the motor to rotate slowly. This initial slow speed of the motor is designed to prepare the apparatus for normal operation, i.e. to remove any slack from the rope **110**, and to start rotating the masses of the motor **113** and of the clutch **112**. The initial slow rotation of the shaft with the drum is assumed to be in the negative direction and as such will cause the sensor to produce the voltage corresponding to negative movement and in this case it will not be recorded by the control processor **120**.

When the user is ready to commence exercise he starts pulling the rope **110** in the positive direction. Positive movement of the rope is detected by the sensor **114** which transmits a signal representative of this motion to the control processor **120** via the sensor interface **121**. In response to the detected positive movement, the control processor **120** immediately applies a signal to the motor control interface **122** corresponding to the predetermined resistance for the commencement of the exercise set. The motor **113** then changes its speed rapidly to the predetermined value which results in the appropriate torque being applied to the drum **111** and in turn the desired resistance being applied to the rope **110**. Throughout the duration of the positive movement of the rope a signal is generated at the output of the sensor **114** and the parameters of this signal are monitored by the processor **120** via the interface **121**. As soon as movement is completed, the sensor indicates to the processor **120** the completion of the positive motion and the processor then applies a signal to the motor control interface **122** to set the resistance to the value selected for negative movement. The resistance for negative movement may have been previously selected to be of the same value, smaller or larger than that for positive motion and the control processor resets the motor speed accordingly. In the meantime the user will commence negative movement. During negative movement the sensor **114** generates a signal representative of the movement which is monitored by the control processor **120**. Upon completion of the negative movement the control processor registers one complete repetition, updates it's records and resets the speed of the motor **113** as required for the next positive movement. This sequence of events repeats itself until the prescribed number of repetitions has been completed. When the prescribed number of repetitions has been completed and if this corresponds to the end of the exercise set, the control processor applies a signal to the motor control interface **122** to lower the motor speed to the originally set idling speed, completes processing of data collected during the exercise programme and displays the results of the exercise, which would typically include the resistance selected, the number of repetitions set and performed, total time of exercise time for individual movements, and the value of energy expended, expressed in calories, on the display **124**. At this stage the user may either abandon further exercises or may return to a main menu of the control processor and select another exercise.

In its simplest form the preferred embodiment of the invention will allow the user to set the exercise parameters, to perform the exercise and to read the final result of the exercise. After terminating the exercise session the data relating to the just completed exercises will usually be lost, although it will be apparent to those skilled in the art that the processor software could be altered without any great difficulty such that data relating to completed exercise sessions was stored for future reference, if this was required, provided that a suitable storage device were connected to the control processor **120**. On the same basis, it is possible to prerecord one or a number of different exercise parameters and later load them into the memory of the control processor **120** and execute them in any order. In particular the function of prerecording and loading, may be achieved by using the computer **130** connected to the control processor **120** via the communications link **133**, in which case, the exercise set may be defined on the computer **130** via the keyboard **132** and stored in mass storage **131**. The newly created exercise set may also be added to a menu of previously recorded exercises and thereafter selected and loaded into the control processor **120** at will. Data relating to a completed exercise set may also be passed back to the computer **130** and displayed on the VDU screen **134**. It will also be recognised that the computer **130** can be simultaneously connected to control processors of a number of different pieces of exercise equipment.

Typically, the parameters which will be displayed to the user on the display **124** would include the number of positive (outward) and negatie (inward) movements of the rope **110**, or alternatively the number of completed repetitions. When the prescribed number of repetitions has been completed, marking the end of the exercise, all counters are stopped and the programme in the control processor displays the remaining part of information relating to the exercise set including total time elapsed for the exercise (in min. and sec.), total time during which an effort was being exerted (in min. and sec.) and calories expended by the user, calculated as a function of the magnitude of resistance (weight) and time of exercise. At the bottom of the screen, a prompt will appear, asking the user for an instruction as to whether the user wishes to perform another exercise or wishes to terminate the exercise session. In the first case he will be returned to the previously mentioned "Main" menu and in the second case the software will cause the session to be terminated in which case the parameters of the loaded exercise set may also be automatically unloaded. Similar displays may be provided on the VDU monitor **132*b*** connected to the computer **130**, although the display provided on the monitor **132** may also display additional information such as a comparison with a previously executed exercise set.

It will be apparent to those skilled in the art that substantially any desired sequence of exercises and type of resistance, whether isotonic, isometric or isokinetic, may be described in the programme of the control processor and that the exercise apparatus will allow the user to perform those exercises at any time.

FIG. 5 shows an example of the behaviour of the exercise apparatus while operating in a simple exercise routine consisting of a single set of 3 repetitions. The programme was set to provide 30 kg restoring force during positive movements and 40 kg during negative movements. It will be noted that after completion of the last (third) repetition the resistance presented drops to the minimal, idling value.

Another example of equipment versatility is shown in FIG. 6 where positive pyramiding was provided in the exercise programme. In this type of exercise, after each repetition (or number of repetitions) the resistance is increased in predetermined steps, building up to the desired maximum and again dropping down to the safe, idling value after completion of the predetermined set of exercises.

The setting of the resistance presented to the user is performed by the control processor **120** through the motor control interface **122**. The processor generates a suitable binary combination which is converted by the motor control interface **122** into an electrical signal suitable for controlling of a motor speed controller **125**. The functional organisation of an example of a sensor interface **121** and motor control interface **122** are presented in FIG. 7, wherein the sensor **114** generates a potential the polarity and magnitude of which are directly proportional to the direction of rotation and the speed of its rotation respectively. Thus the potential generated by the sensor **114** is amplified by the amplifier **140** and applied to the logic circuits **141** and directly represents the effort of the exercising user. Logic circuits **141** convert the potential received from the sensor into typical logic patterns and levels as required by the computer for its correct operation, and applies these signals to the control processor **120** via wires **142**. The binary signals generated by the logic circuit **141** might, for example, comprise a first signal which only switches to the active state when the sensor **114** is moving in the positive direction and a second signal which only switches to the active state when the sensor **114** is moving in the negative direction. These signals may also carry information relating to the speed of the sensor **114**. The control processor **120**, in accordance with the parameters of the exercise set being performed, applies a binary combination via wires **150** to the digital-to-analog converter **151** which converts the binary combination and levels into an analog signal at its output **152**, related to the binary value represented on wires **150**. The analog signal **152** is then amplified by amplifier **153** and the output signal **154** is applied to the motor speed controller **125**. It will be apparent that the accuracy of the speed setting, and thus accuracy of the setting of the resultant resistance, depends upon resolution of the digital-to-analog converter **151**. If, for example, the digital-to-analog converter would cover the whole range of desired motor speeds in four steps only, this will result in a very crude speed adjustment changing in steps of 25%. A wide range of DAC converters are now commercially available and devices are available which will provide very high resolution if it is required. It will be apparent to those skilled in the art that essentially any commercially available DAC unit, most of which provide at least 8 bit accuracy, will provide sufficient accuracy to meet the requirements of the user of the present invention when coupled with a suitable commercially available motor speed controller **125**.

Referring now to FIGS. **8**A, B, C and D, an example of a control programme for the control processor **120** of FIG. **4** is illustrated in the form of a flow diagram. The control programme of FIG. **8** is designed as a routine which exists within a main system programme from which it is called, the main programme being responsible for initialisation of the processor and the provision of functions such as the real time clock.

Upon entry into the exercise control routine at START **201** a menu of predefined exercise sets and variable exercise sets is displayed **202** on the display **124** and input data is accepted **203**, **204** via the keypad **123** until such time as a complete programme of exercise sets has been defined. The chosen exercise sets are then displayed **205** on display **124**.

Having defined a programme of exercise sets, the electric motor **113** is started **206** with its speed set to idle in order to take up any slack in the cable **110** and the signal from the sensor **114** is monitored **207**, **208** until a positive movement indicates that the user has commenced to exercise. At this point the time of the commencement of the exercise set is noted **209** and a signal is applied **211** to the motor control interface **122** to run the motor at a speed corresponding to the chosen resistance for the first positive movement of the exercise set. The programme then monitors the sensor **114** until the end of the positive movement is detected **212**, **213** at which time a positive movement counter is incremented, the incremented movement count is displayed **215** on display **124**, and the motor speed is set **216** in accordance with the chosen resistance for the following negative movement of the exercise set. The sensor **114** is then monitored until the end of the negative movement **217**, **218**, when a negative movement counter is incremented **219** and displayed **221** and a repetition counter is incremented **222** and tested **223** to determine if the prescribed number of repetitions have been completed. If the prescribed number of repetitions has not been completed the motor speed is set **211** in accordance with the resistance chosen for the next positive movement and the repetition cycle **211**–**223** is repeated.

When the number of repetitions in an exercise set is equal to the prescribed number, a sets counter is incremented **224**, displayed **225** and tested **226**. If the number of sets completed is not equal to the number programmed, the motor is set to idle **227** and a rest period is measured **228**, **229**, **231**, before setting the motor speed for the first positive movement **211** of the next set and repeating the set cycle **211**–**226**.

When the programmed number of exercise sets has been completed the motor is again set to idle **232** and the total time for the exercises performed is calculated **233**, **234** as well as the energy expended **235** and this information is then displayed **236** on display **124** and the motor is stopped **237**. Having displayed the information relating to the completed exercises, the keypad is enabled **238**, **239** to allow the user to select **241** between terminating the exercise session, in which case the exercise control routine is exited **242**, or alternatively selecting further exercises in which case the startup menu is displayed **202** and the entire exercise routine **202**–**239** is repeated.

In the embodiment of the invention described with reference to FIGS. **2**, **3** and **4**, a cable **110** is employed to transmit the forces exerted by the user through the clutch **112** to the motor **113**. It will be apparent to those skilled in the art that the force may be applied in alternative directions by making use of a suitable system of pulleys such that the direction of motion of the rope

110, and therefore of application of force by the user, may be changed at will.

The following advantages are among those obtained by the preferred embodiment of the present invention:

1. The equipment allows a choice to be made between isotonic, isometric and isokinetic resistance with a wide range of resistance increments.
2. The principle of operation of the apparatus allows positive (concentric) and negative (eccentric) movements to be performed with different resistance, a feature not normally offered by the ordinary weightstack equipment.
3. The functioning of the apparatus is fully programmeable and thus complex exercises such as pyramiding are possible.
4. The performance characteristics of the apparatus are able to be accurately controlled, and are therefore repeatable for successive users and training sessions. No special attention is required on the part of the user to achieve consistent performance of the equipment.
5. A single apparatus may be adapted to a variety of highly specialised exercises via simple programme changes. Previously, multiple devices were required to achieve this versatility.
6. Through gradual modifications of programme, athletes may be adaptively trained for optimum performance. Previously, apparatus having the required level of precision and consistency was not available.
7. In combination with suitable bio feedback displays, an athletes' performance may be controlled and analyzed, thereby permitting determination of the athletes abilities and suitability for particular type of exercise. Such analysis and assessment is not possible with the current exercise equipment.
8. The preferred combination of components for accomplishing these objectives of the preferred embodiment is not expensive to manufacture and assemble.
9. The absence of the heavy weightstack makes the equipment inherently safe to use and allows the equipment to be of relatively low overall weight, allowing it to be used in substantially any location without floor loading problems.
10. If desired, the speed of cable movement may be separately monitored so that if it exceeds a certain predetermined value in the negative direction, the motor may be turned off, thus removing resistance against which the user exerts himself. This unique feature may protect the user from serious injury if during an exercise high resistance exceeds performance of his muscles. Such protection is not achievable with the ordinary weightstack.

To those skilled in the art to which this invention relates, these and other advantages of this programmeable exercise apparatus will be apparent. Many changes in construction and widely different embodiments and applications will suggest themselves without departing from the spirit and scope of the invention.

We claim:

1. An exercise apparatus comprising:

a rotary driving means for generating a torque, said rotary driving means having a variable speed of rotation;

an adjustable speed control means, operably connected to said rotary driving means, for varying the speed of rotation of said rotary driving means;

an exercise element for manipulation by a user, said manipulation imparting a motion to said exercise element;

torque transmission means, operably connecting said rotary driving means and said exercise element, for providing a resistance to said user's manipulation of said exercise element and allowing for lost motion between said rotary driving means and said exercise element, said torque transmission means transmitting torque from said rotary driving means to said exercise element, said transmitted torque being of a magnitude that is substantially indepenent of said exercise element motion and is dependent only upon said speed of rotation of said rotary driving means.

2. The exercise apparatus of claim **1** wherein the driving device is an electric motor, the torque transmitting means is a fluid coupling and the exercise element is a drum about which an elongate flexible element is wound.

3. The exercise apparatus of claim **2** wherein the fluid coupling is a hydraulic coupling.

4. The exercise apparatus of claim **3** wherein the hydraulic coupling is a constant fluid level coupling.

5. The exercise apparatus of claim **3** wherein the hydraulic coupling is a variable fluid level coupling.

6. The exercise apparatus according to claim **2** wherein the speed of rotation of said electric motor is controlled by a motor control circuit in response to a motor control signal.

7. The exercise apparatus according to claim **6** wherein a sensing means is provided to monitor rotation of the drum.

8. The exercise apparatus of claim **7** wherein the sensing means is a tacho-generator.

9. The exercise apparatus of claim **7** wherein the sensing means is a shaft encoding device.

10. The exercise apparatus according to claim **7** wherein control means are provided, said control means being adapted to control said motor speed and to monitor an output signal of said sensing means, representative of the direction of rotation of said drum.

11. The exercise apparatus according to claim **10** wherein the sensing means output signal is also representative of speed of rotation of said drum.

12. The exercise apparatus according to claim **10** wherein the control means is responsive to the sensing means output signal to vary the speed of the electric motor in response to the direction of rotation of the drum.

13. The exercise apparatus of claim **12** wherein the control means is programmeable to control the motor speed during an exercise session such that effort required to be exerted by a user of the apparatus during the exercise session is varied according to a predetermined programme.

14. The exercise apparatus as claimed in claim **13** wherein the motor speed is varied for successive concentric and eccentric movements of the apparatus during a set of exercises.

15. The exercise apparatus as claimed in claim **13** wherein the motor speed is varied for successive repetitions of an exercise within a set of exercises.

16. The exercise apparatus as claimed in claims **13** wherein the control means includes storage means for storing statistics relating to an exercise session just completed or still in progress and display means for displaying the statistical information to the user.

17. The exercise apparatus as claimed in claim 16 wherein the control means is a computer.

18. The exercise apparatus as claimed in claim 17 wherein the display means comprises a set of alpha numeric display elements.

19. The exercise apparatus as claimed in claim 18 wherein the display means comprises a Visual Display Unit.

20. The exercise apparatus as claimed in claim 13 wherein the control means is programmed to provide a plurality of exercise programmes and includes input means to select one or more programmes to be performed, selected from said plurality of programmes.

21. The exercise apparatus as claimed in claim 20 wherein additional exercise programmes, apart from those held in the control means, may be defined and entered into the control means via said input means.

22. The exercise apparatus as claimed in claim 10 wherein the control means is adapted to respond to rotation of said drum in a negative direction at greater

than a predetermined speed by stopping the electric motor.

23. An exercise apparatus comprising:

an electric motor having a variable speed of rotation;

an adjustable speed control means, operably connected to said motor for varying the speed of rotation of said motor;

an exercise element for manipulation by a user, said manipulation imparting a rotary motion to said exercise element;

torque transmission means, operably connecting said motor and said exercise element and allowing for lost motion between said motor and said exercise element, said torque transmission means transmitting torque from said motor to said exercise element so as to provide a resistance to said user's manipulation of the exercise element, the torque transmitted being of a magnitude that is substantially independent of said exercise element motion and is dependent only upon said speed of rotation of said electric motor.

* * * * *

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APPENDIX Z

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Fenster

(54) **APPARATUS FOR COUNTING REPETITIONS OF AN EXERCISE DEVICE**

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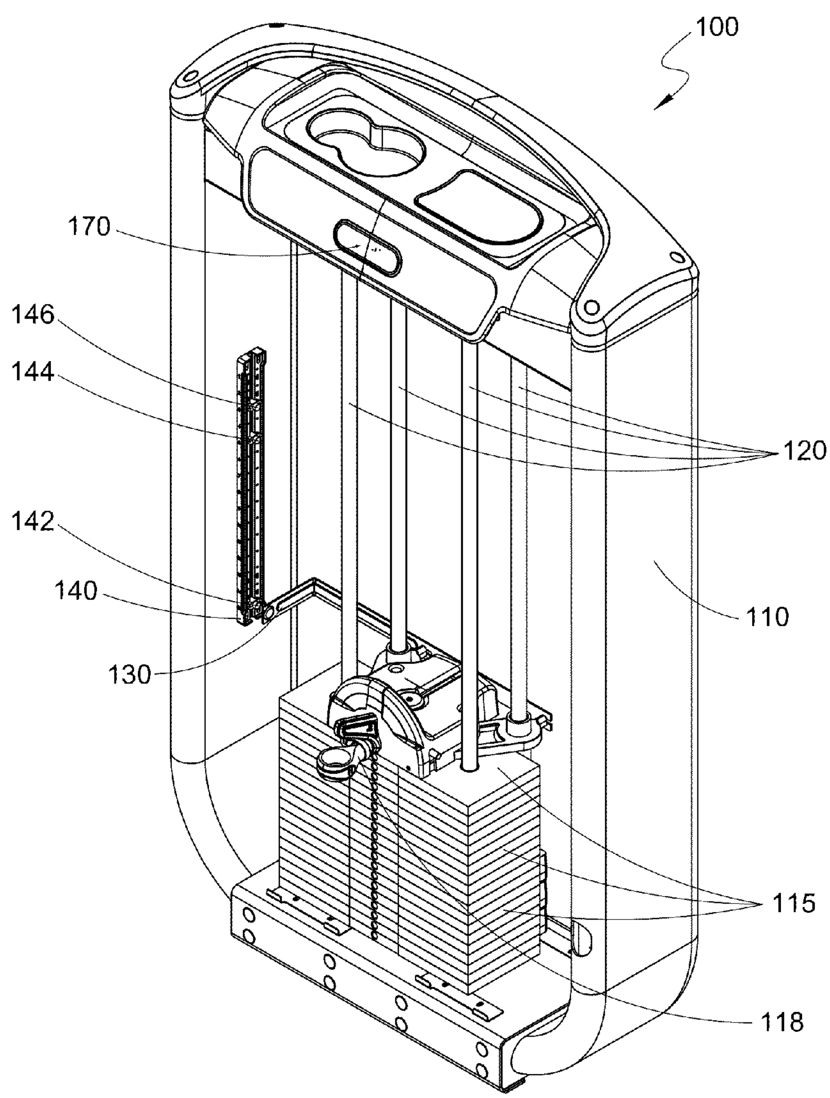
(52) **U.S. Cl.** **482/8**

(57) **ABSTRACT**

An apparatus for counting repetitions of an exercise device including a frame with at least one guide member, a movable component guided to travel along a path by the at least one guide member, the path having a start position, a first position, and a second position, first and second proximity sensors attached to the frame, the first proximity sensor transmitting a first signal when the movable component is located near the first position, and the second proximity sensor transmitting a second signal when the movable component is located near the second position, an electronic counter set up to receive the first and second signals so that the electronic counter can count the number of repetitions of travel of the movable component along the path, a memory storage device for storing the repetition count, and a display device able to display the rep count.



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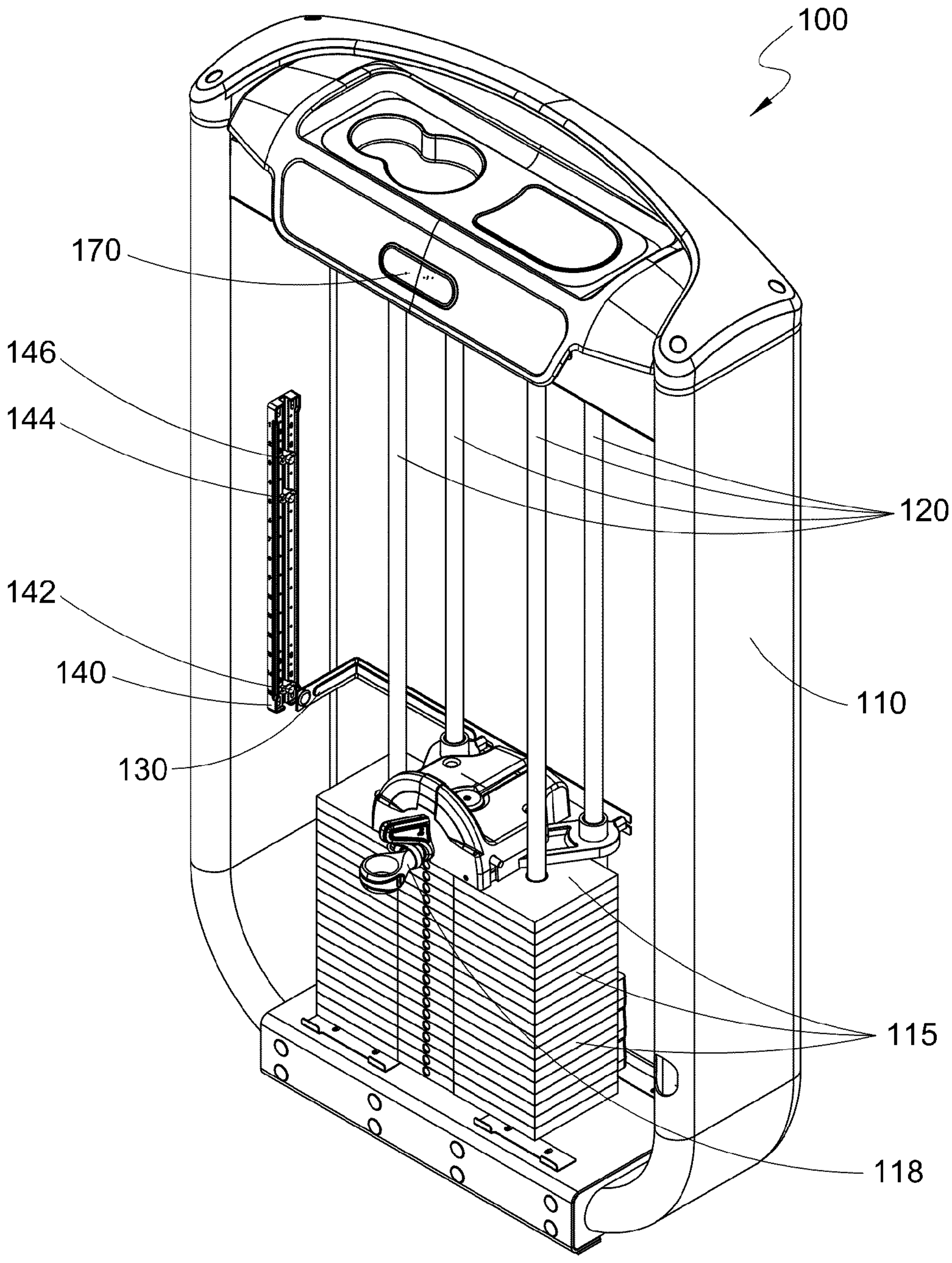

FIG. 1

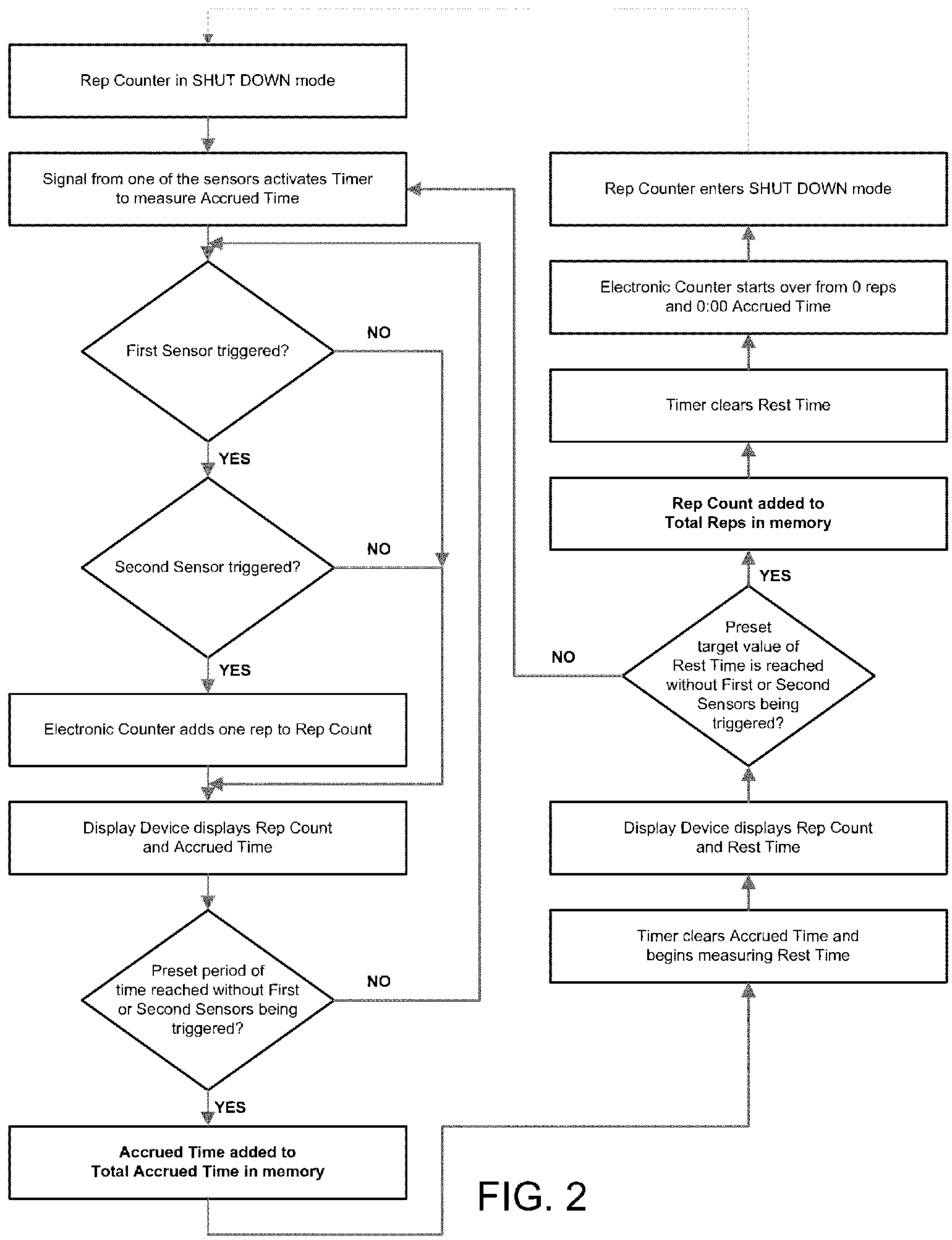
Rep Counter in SHUT DOWN mode
Signal from one of the sensors activates Timer to measure Accrued Time
First Sensor triggered?
NO
YES
Second Sensor triggered?
NO
YES
Electronic Counter adds one rep to Rep Count
Display Device displays Rep Count and Accrued Time
Preset period of time reached without First or Second Sensors being triggered?
NO
YES
Accrued Time added to Total Accrued Time in memory
Rep Counter enters SHUT DOWN mode
Electronic Counter starts over from 0 reps and 0:00 Accrued Time
Timer clears Rest Time
Rep Count added to Total Reps in memory
YES
Preset target value of Rest Time is reached without First or Second Sensors being triggered?
NO
Display Device displays Rep Count and Rest Time
Timer clears Accrued Time and begins measuring Rest Time

FIG. 2

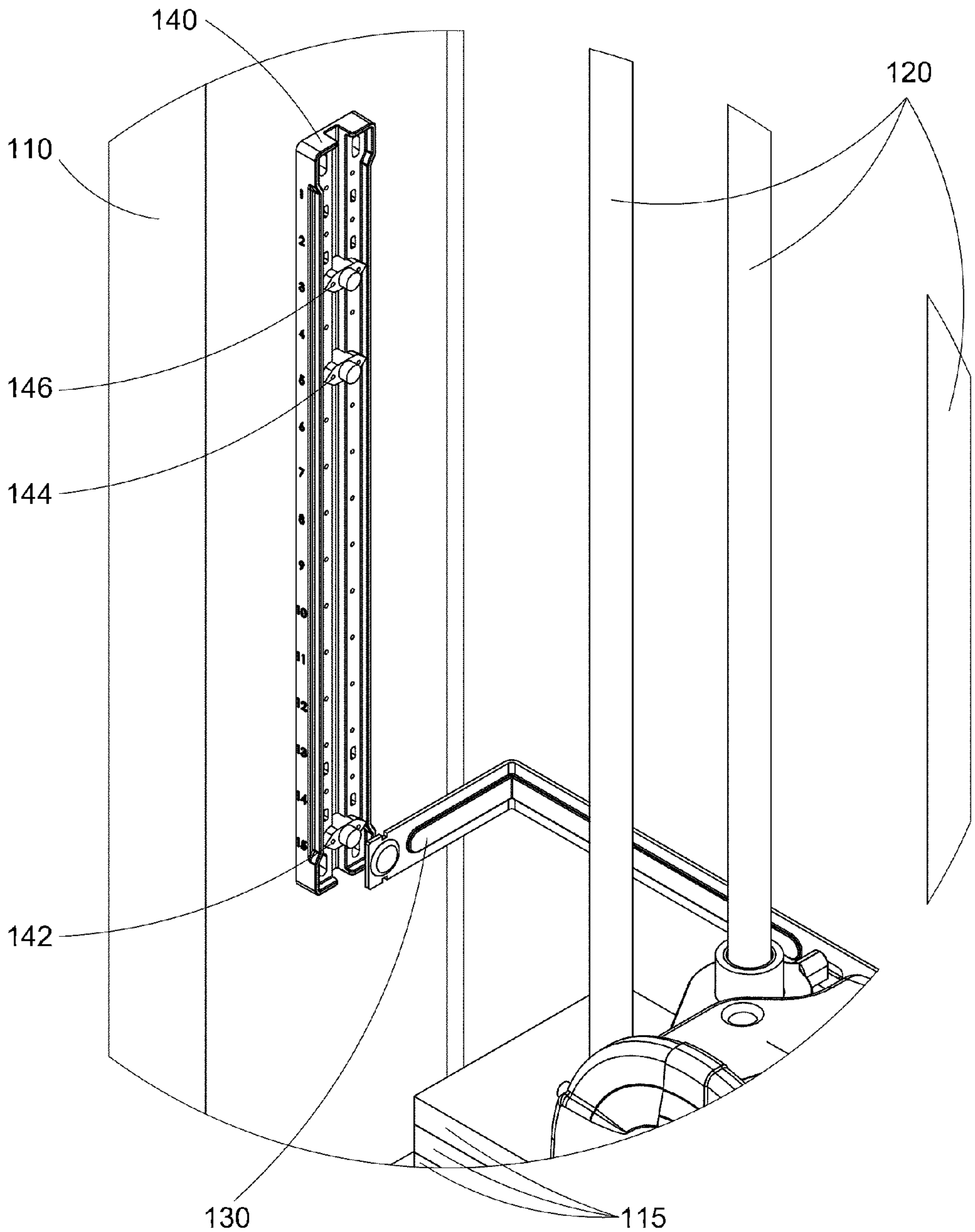

FIG. 3

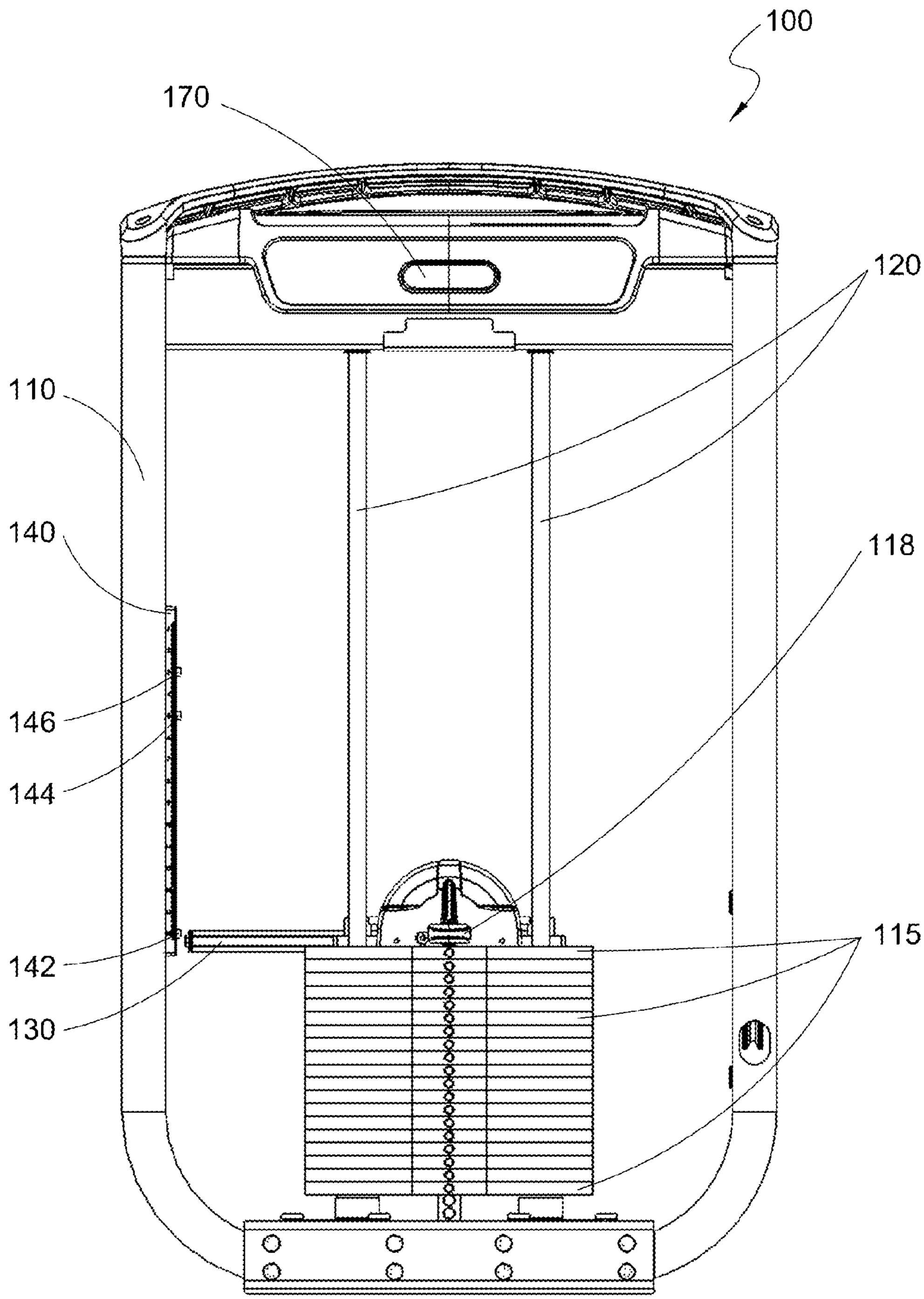

FIG. 4

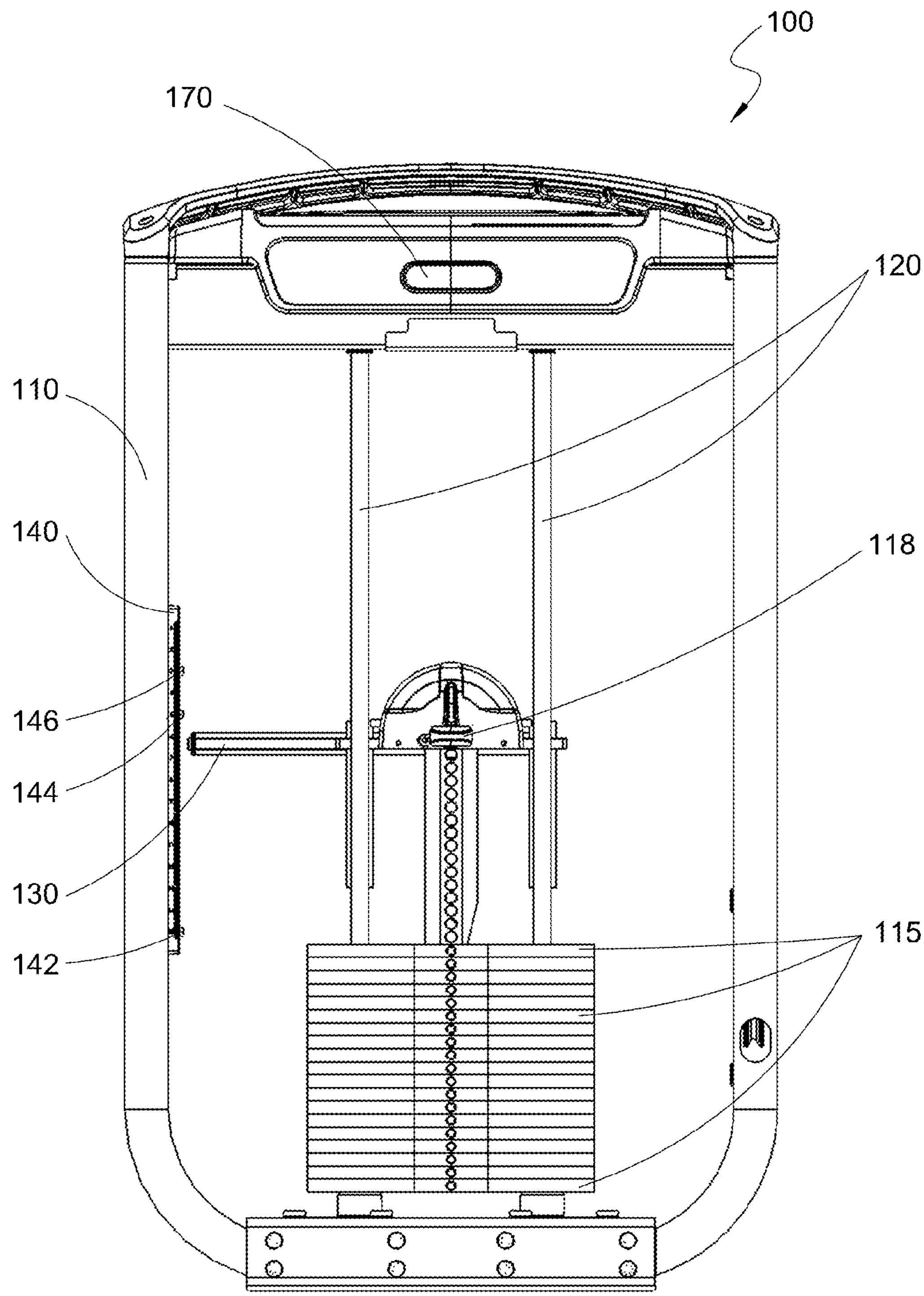

FIG. 5

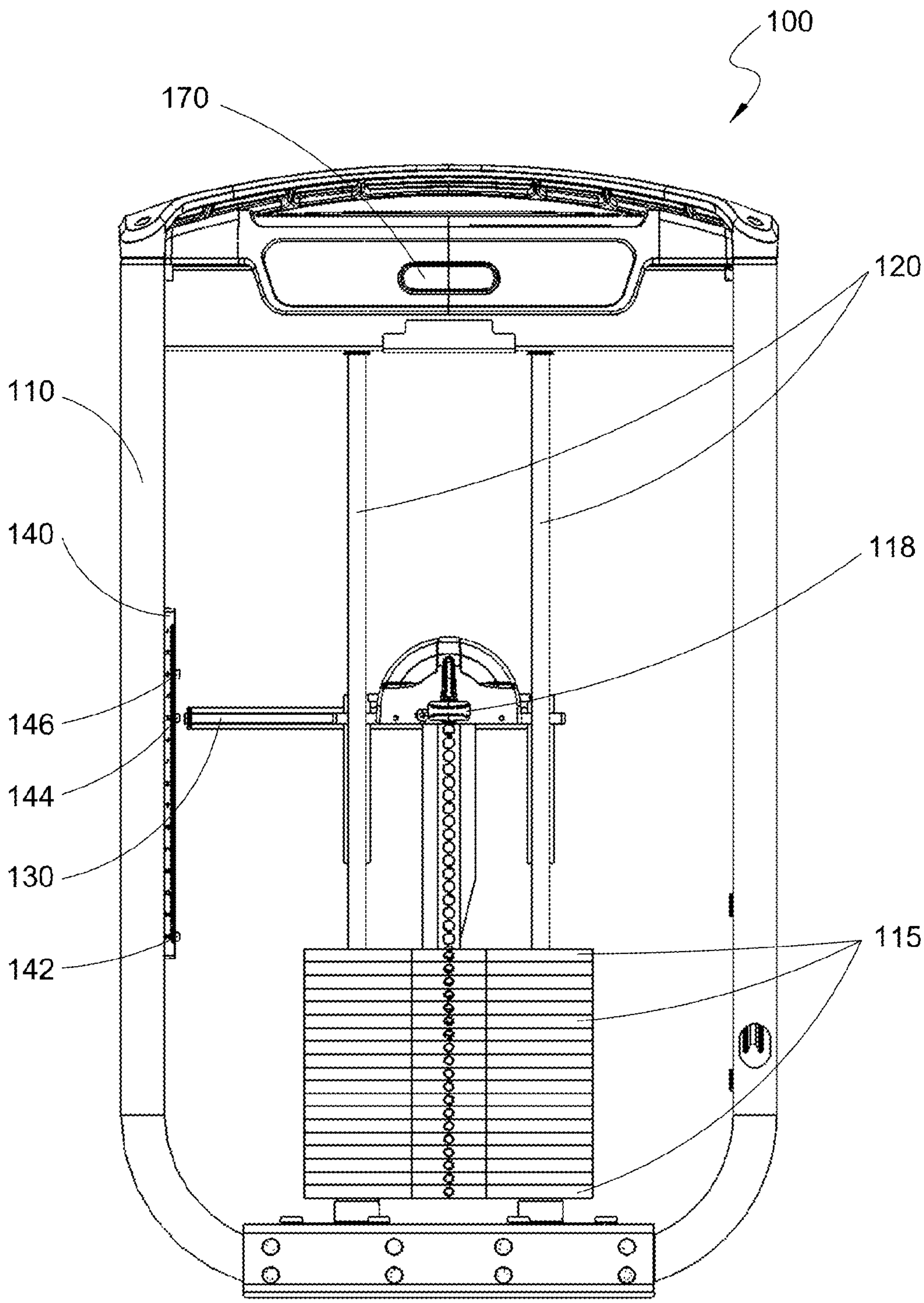

FIG. 6

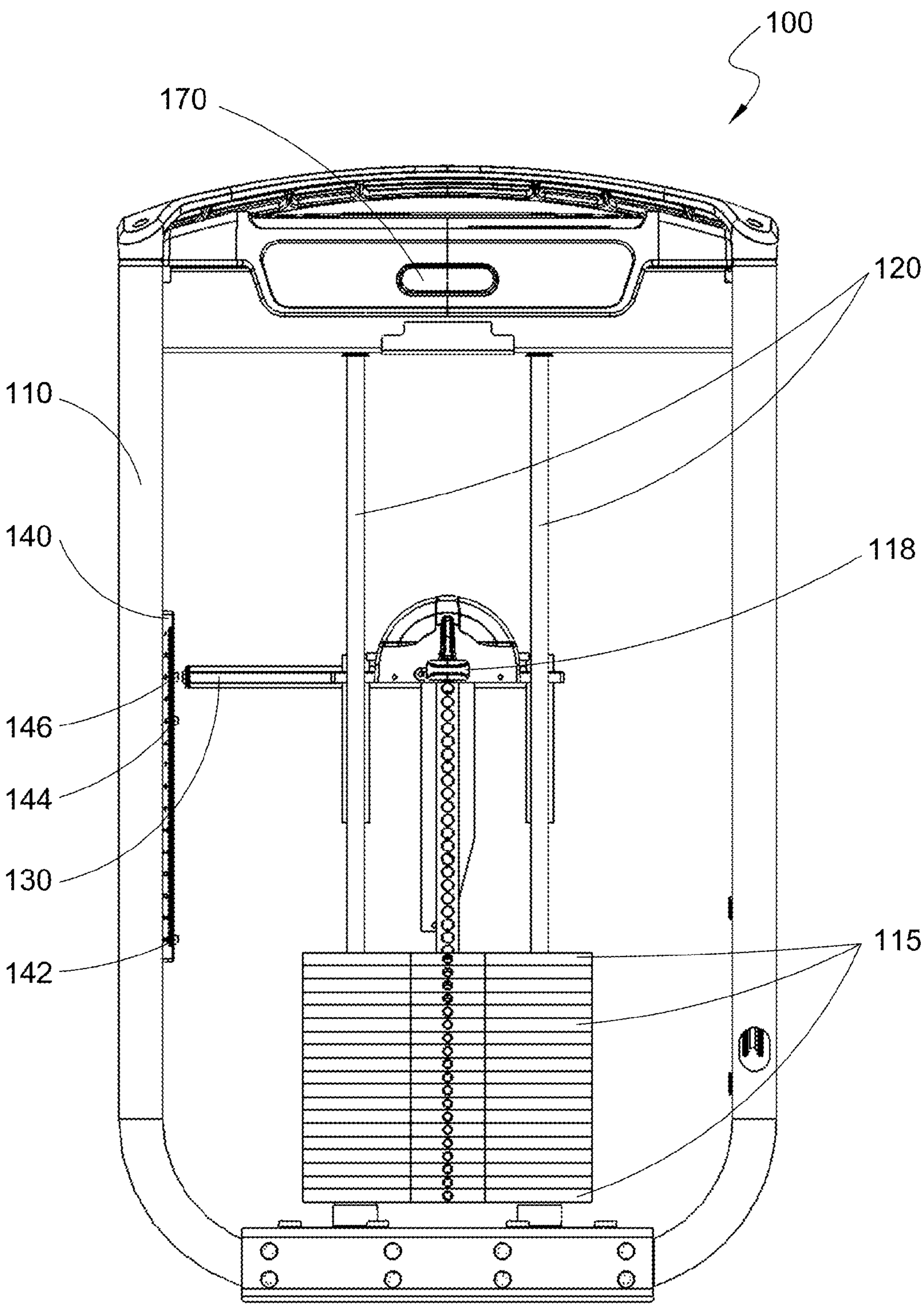

FIG. 7

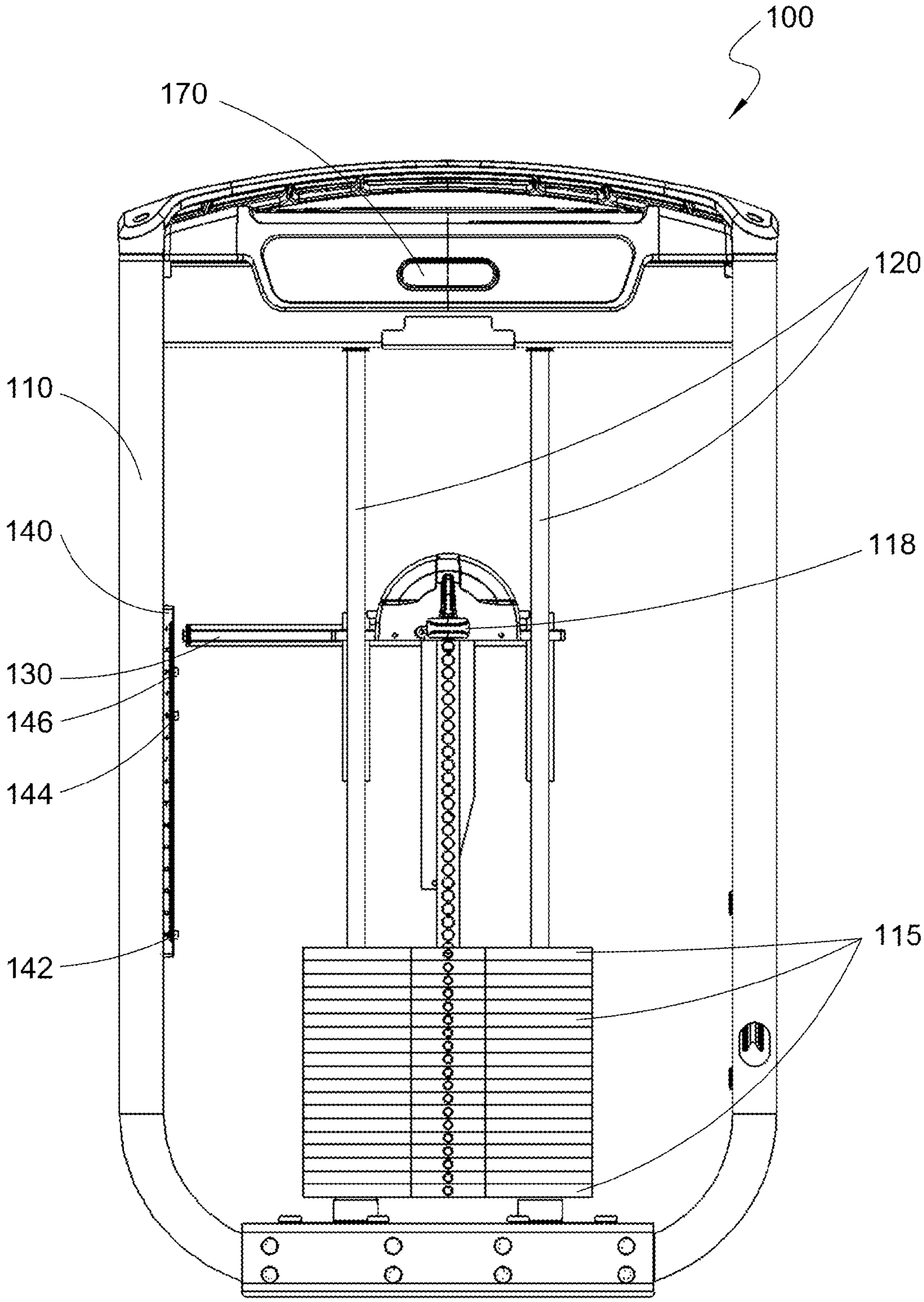

FIG. 8

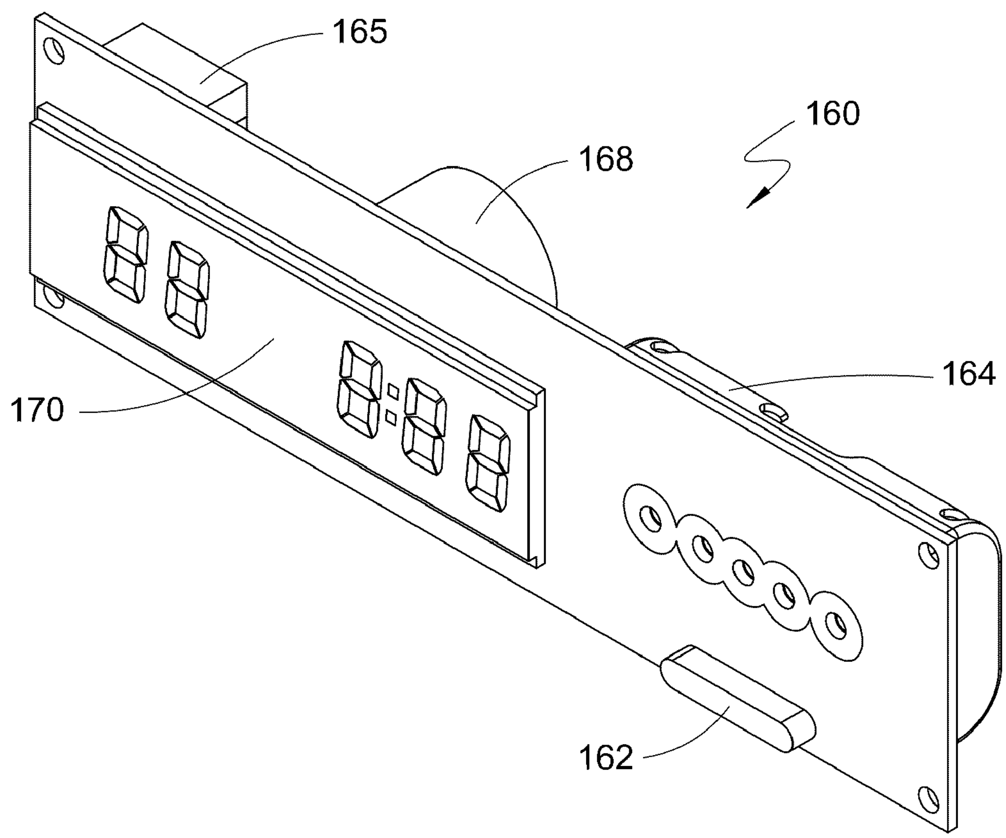

FIG. 9

APPARATUS FOR COUNTING REPETITIONS OF AN EXERCISE DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates generally to an apparatus for counting repetitions of an exercise device and, more specifically, to a rep counter apparatus for counting repetitions of a strength exercise device.

[0003] 2. Background

[0004] Stationary exercise apparatus have been popular for several decades. While physical labor or sports are two ways that people can exercise their bodies, people increasingly turn to stationary exercise apparatus when they want to lose weight or tone muscles.

[0005] Stationary exercise apparatus are often categorized into one of two groups: cardiovascular exercise equipment and strength equipment. Cardiovascular exercise equipment (sometimes called cardio exercise devices or aerobic exercise equipment) generally include machines or apparatus configured so that an operator can elevate his/her heart rate by exercising continuously over a relatively prolonged period of time. Stationary cardio exercise equipment generally includes exercise devices such as treadmills, stationary exercise bicycles, elliptical trainers, rowers, steppers, and so forth.

[0006] Strength equipment, by contrast, generally includes machines or apparatus configured to provide an operator with brief, relatively intense resistance over a relatively short period of time. Performing an exercise session on strength equipment typically involves performing multiple repetitions of a repetitive exercise, where the each repetition of the exercise (or rep) typically involves moving a movable object a relatively short distance against a relatively intense force over a relatively short period of time. Strength equipment generally includes exercise devices such as elastomeric resistance devices, free weights, and selectorized strength equipment (exercise equipment utilizing the weight of a stack of weight plates as resistance to the exercise, where the operator may select the number of weight plates to be lifted by the operator to adjust the resistance of the exercise). Examples of strength equipment are bicep arm curl machines, chest press machines, and leg press machines.

[0007] An important component for exercise devices is the ability to accurately monitor the operator's progress through a given workout program, which may include exercises on both cardio and strength equipment. The amount of exercise performed can generally be correlated to the amount of work done by the operator.

[0008] Many cardio exercise devices implement some form of electronic monitoring apparatus that measures or records such information as the duration the operator has been exercising on the device, the resistance setting of the exercise device, and the number of rotations of a crank arm or a flywheel. These devices then often calculate information such as the resistance level, speed, distance traveled, time elapsed, and calories burned during the exercise, and provide the information to the operator in the form of an electronic display.

[0009] Strength exercise equipment, by contrast, has not traditionally utilized electronic monitoring apparatus. If utilized, strength equipment would require a different type of monitoring device, since strength exercise equipment does not typically rely on continuously rotating parts. Additionally, the amount of work an operator undertakes is more directly tied to resistance level, distance traveled by a movable component during each repetition, and number of repetitions, rather than being tied to time or speed. Based on resistance level, distance traveled, and number of repetitions, the amount of work performed, or calories burned, can be calculated. For many strength equipment operators, however, a calculation of calories burned may not be the most desirable feedback. The amount of weight being lifted, and the number of completed repetitions (or reps), is the often the most valuable information to the operator.

[0010] An operator often has a target for the number of reps he/she would like to perform at a certain weight level, and the operator often only counts the "good" reps, which are repetitions where the operator performs the exercise through the full range of motion for that particular exercise. If the operator cannot perform the exercise through the full range of motion for a particular exercise, the operator may choose not to count the rep, because it was an incomplete rep.

[0011] An operator using strength equipment therefore is most interested in tracking the number of "good" reps performed for each exercise. It is important for a monitoring device coupled to strength equipment to avoid inaccurately detecting multiple repetitions when a single repetition has been conducted. Alternatively, it is important for a monitoring device coupled to strength equipment to count all "good" repetitions that have been performed. Since accurate measurements of this sort of data can be important to a workout program, it is important for the monitoring device coupled to strength equipment to accurately count the number of "good" reps performed by the operator, while not counting the repetitions which are incomplete reps.

[0012] Accordingly, there is still a need for a rep counter apparatus that can accurately measure and display the number of good repetitions an operator performs on a piece of strength exercise equipment, while avoiding counting the incomplete repetitions that would not be considered "good" reps by the operator. Furthermore, there is still a need for a rep counter apparatus that can record the total accumulated number of repetitions and the total accumulated number of hours of usage for a piece of strength equipment.

SUMMARY

[0013] The present invention discloses an apparatus for counting the repetitions of various types of strength exercise machines. The apparatus for counting repetitions of an exercise device includes a frame with one or more guide members and a movable component that is moved along a path when an operator applies a force to the exercise device. The movable component is guided along the path by the one or more guide members. The path has a start position, a first position, and a second position. The movable component is located at the start position before the operator applies a force to the exercise device, the movable component leaves the start position to move along the path when the operator applies the force to the exercise device, and the movable component returns to the start position after the operator ceases to apply the force to the exercise device.

[0014] The apparatus for counting repetitions, or rep counter apparatus, includes at least first and second proximity sensors, where the first proximity sensor detects the presence of the movable component when the movable component is located near the first position along the path, and the second proximity sensor detects the presence of the movable component when the movable component is located near the

second position along the path. The first proximity sensor transmits a first signal when the first proximity sensor detects the presence of the movable component, and the second proximity sensor transmits a second signal when the second proximity sensor detects the presence of the movable component.

[0015] The apparatus for counting repetitions includes an electronic counter, a memory storage device, and a display device, where the memory storage device stores a rep count representing the number of repetitions of the movable component moving along the path, and the display device displays the rep count. The electronic counter receives the first and second signals, and when the electronic counter receives the first signal followed by the second signal, the electronic counter takes the current rep count from the memory storage device, increments the rep count by one, and returns the new rep count to the memory storage device and to the display device. The memory storage device may store additional information, such as the total number of repetitions that have ever been performed on the exercise apparatus.

[0016] The apparatus for counting repetitions may be designed to count only good repetitions (or good reps). For strength equipment, a good rep could be defined as an exercise involving a movable component moving through a minimum acceptable distance, or a minimum acceptable range of motion. A good rep would occur, for instance, when a movable component on the exercise apparatus travels at least the distance along a path between a first position and a second position, assuming the first position and the second position were chosen appropriately for a particular exercise on the exercise apparatus. The distance between the first position and the second position set a minimum acceptable distance for the exercise apparatus. Assuming the appropriate locations were chosen for the first position and the second position, the travel of a movable component moving along a path between the first and second positions by the movable component would constitute a good rep, and the minimum acceptable distance would have been travelled by the movable component.

[0017] If the movable component moves along a path and reaches the first position, but does not travel far enough along the path to reach the second position, then the minimum acceptable distance has not been travelled by the movable component, and this is an incomplete rep which should not be counted by the rep counter apparatus. Similarly, once the movable component is positioned near the second position, if the movable component does not move back along the path to return to the first position, then no matter how many times the movable component crosses over the position of the second position, the minimum acceptable distance has not been travelled by the movable component, and this is also an incomplete rep which should not be counted by the rep counter apparatus.

[0018] For most strength exercise equipment, there is a resistance system set up to act upon a movable component, so that the resistance system resists travel of the movable component in a first direction. Often, the resistance system assists the travel of the movable component in a second direction opposite to the first direction. For example, a strength exercise device that uses weights as the resistance system applies a load in one direction, because gravity pulls downward on the weights. For strength exercise equipment that use weights for the resistance system, when the movable component moves in a direction that lifts the weights against the force of gravity, the resistance system resists the travel of the movable component in the first direction. Conversely, when the movable component moves in a direction that lowers the weights so that the force of gravity is assisting in the lowering of the weights, the resistance system assists the travel of the movable component in the second direction. For strength exercise equipment utilizing this type of resistance system, it is important that the apparatus for counting repetitions be designed to count only those reps where the movable component is moving in the first direction, where a resistance system is resisting the travel of the movable component. That is, the apparatus for counting repetitions can be designed so that the apparatus for counting repetitions only counts those repetitions where the movable component first reaches the first position, and then continues along the path to the reach the second position.

[0019] In one embodiment, the second position is located above the first position, and the first position is located above the start position. In this embodiment, as the movable component moves along the path away from the start position, it moves toward the first position, and if the movable component continues along in the same direction, it reaches the first position and continues on toward the second position. The location of the first proximity sensor defines the first position and the location of the second proximity sensor defines the second position.

[0020] In another embodiment, the apparatus for counting repetitions includes a timer. The timer can be used to measure accrued time (the amount of time accrued since the start of the exercise session) when the electronic counter receives a signal from one of a plurality of proximity sensors. The timer can also be used to measure rest time when the electronic counter has received no signal within a preset period of time. Either the accrued time and/or the rest time can be displayed on the display device.

[0021] This summary is not meant to be exhaustive. The features and advantages of the present invention will become more fully apparent from the following description, accompanying drawings and appended claims. In the description, reference is made to the accompanying drawings, which form a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. It is to be understood that other embodiments may be utilized and that structural changes may be made without departing from the scope of the invention. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is best defined by the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] FIG. **1** is a perspective view of an exercise apparatus including a rep counter apparatus constructed according to the principles of the present invention.

[0023] FIG. **2** is a flow diagram outlining the operation of the rep counter of the present invention.

[0024] FIG. **3** is a detail view of a portion of the rep counter apparatus of FIG. **1**.

[0025] FIG. **4** is a front view of the exercise apparatus of FIG. **1** with a movable component located at a start position.

[0026] FIG. **5** is a front view of the exercise apparatus of FIG. **1** with the movable component located between the start position and a first position.

[0027] FIG. **6** is a front view of the exercise apparatus of FIG. **1** with the movable component located at the first position.

[0028] FIG. **7** is a front view of the exercise apparatus of FIG. **1** with the movable component located at a second position.

[0029] FIG. **8** is a front view of the exercise apparatus of FIG. **1** with the movable component located above the second position.

[0030] FIG. **9** is a perspective view the rep counter of FIG. **1**.

DETAIL DESCRIPTION

[0031] The present invention relates to an apparatus for counting repetitions of an exercise device such as a strength exercise device. In particular, the apparatus for counting repetitions, or rep counter apparatus, is designed to be installed into a weight tower of a strength exercise apparatus.

[0032] A weight tower for strength exercise apparatus is often configured as a modular device, where a single weight tower design is intended to be used with any one of a plurality of different strength exercise apparatus. The weight tower provides resistance to the exercise apparatus, regardless of the type of exercise apparatus to which it is joined. An operator of a strength exercise apparatus may adjust the amount of resistance provided by the weight tower, and then may exercise against the resistive load provided by the weight tower. For instance, a weight tower may be combined with a leg press exercise device to provide a resistance load to a foot plate on the leg press exercise device, allowing an operator to exercise the legs. The same weight tower may instead be combined with a chest press exercise device to provide a resistance load to a handlebar on the chest press exercise device, allowing an operator to exercise the upper body. A rep counter apparatus installed into a weight tower of a strength exercise apparatus may provide feedback to the operator of the exercise apparatus, regardless of which type of strength exercise device is joined to the weight tower.

[0033] The apparatus for counting repetitions, or rep counter apparatus, is designed to count good reps and to not count incomplete reps. Furthermore, the rep counter apparatus may include a memory storage device and a timer, allowing the rep counter apparatus to store information in memory such as the rep count during an exercise session, the accrued time of usage during an exercise session, the total number of repetitions of the exercise device, and the total accrued time of usage of the exercise device. Additionally, the rep counter apparatus may include a display device, allowing the rep counter apparatus to display information such as the rep count during an exercise session, the accrued time of usage during an exercise session, the rest time during an exercise session during which a movable component is not sensed to be moving, the total number of repetitions of the exercise device, and the total accrued time of usage of the exercise device.

[0034] FIG. **1** illustrates a weight tower **100** for a strength exercise apparatus, including a frame **110**, a number of guide members **120**, and a movable component **130** guided along a path by at least one of the guide members **120**. Weight plates **115** are supported by the frame **110**, with a selector mechanism **118** for selecting the number of weight plates **115** to be lifted with the movable component **130** during exercise. A sensor track **140** is shown with a first proximity sensor **144**, and a second proximity sensor **146**. In addition, a start position proximity sensor **142** is shown in alignment with the movable component **130** when the movable component **130** is in its lowest, start position. A display device **170** is shown for displaying information such as number of reps completed or the accrued time of usage of the exercise apparatus during the exercise session.

[0035] Not shown in FIG. **1**, but shown in FIG. **9**, is an electronic counter **160**, with a battery **164** for supplying electrical energy to the electronic counter **160**. Furthermore, the electronic counter **160** includes a memory storage device **165**, a timer **168**, and a display device **170**, which are in communication with each other. While the battery **164**, the memory storage device **165**, the timer **168**, and the display device **170** are shown attached to the electronic counter **160**, it would be obvious to one skilled in the art that these could each be separate components. As long as these components have the ability to communicate with each other, the individual components would not need to be located in the same area as the electronic counter **160**.

[0036] Also shown in FIG. **9** is a magnetic reed switch **162**, which may be used to instruct the electronic counter **160** to switch between modes, such as an operator mode, where the display device **170** displays time and rep count information specific to an exercise session, and a usage mode, where the display device **170** displays total accrued time of use and total rep count for the exercise apparatus.

[0037] Referring again to FIG. **1**, the movable component **130** is configured to be moved in response to a mechanical stimulus generated during repetition movement, for instance during an exercise session that requires lifting of a selected number of weight plates **115** along a path from a start position to a raised position. During the exercise session, the movable component **130** may be guided by the at least one guide member **120** along a path that has a start position, a first position, and a second position. In the embodiment shown, the first position is above the start position, and the second position is above the first position. Eventually, at the completion of the exercise session, the mechanical stimulus ceases to be applied, and the selected weight plates **115** and the movable component **130** are returned to the start position.

[0038] The sensor track **140** is mounted to the frame **110** and provides a convenient method for quickly mounting the first proximity sensor **144**, the second proximity sensor **146**, the start position proximity sensor **142**, and any other desired sensors to locations along the frame **110**. The first proximity sensor **144** is positioned on the sensor track **140** at a first position, and the second proximity sensor **146** is positioned on the sensor track **140** at a second position. As the movable component **130** travels along the path, the various proximity sensors detect the presence of the movable component **130** as the movable component **130** moves past each respective proximity sensor, and the respective proximity sensor sends out a signal to the electronic counter **160** when the respective proximity sensor detects the presence of the movable component **130**. The electronic counter **160** receives the incoming signals from the proximity sensors.

[0039] The memory storage device **165** stores information including a rep count. The rep count is a measure of the number of times the movable component **130** triggers the second proximity sensor **146** to send a second signal to the electronic counter **160**, after the electronic counter **160** has first received a first signal from the first proximity sensor **144**. In other words, the electronic counter **160** is configured to increment the rep count by one when the electronic counter **160** receives a signal first from the first proximity sensor **144** and then from the second proximity sensor **146**. The electronic counter **160** will only increment the rep count when the electronic counter **160** receives the second signal from the second proximity sensor **146** immediately after receiving the first signal from the first proximity sensor **144**. The electronic counter **160** is configured not to increment the rep count upon receiving a signal from the first proximity sensor **144**. It is only the signal from the second proximity sensor **146** which will cause the electronic counter **160** to increment the rep count. But the electronic counter **160** will also not increment the rep count upon receiving a signal from the second proximity sensor **146** if that signal was not immediately preceded by a first signal from the first proximity sensor **144**.

[0040] The first proximity sensor **144** sends a first signal to the electronic counter **160** which primes the electronic counter **160**. The electronic counter **160** does not increment the rep count upon receiving this first signal, but the first signal from the first proximity sensor **144** does ready the electronic counter **160** to await a second signal from the second proximity sensor **146**. If the electronic counter **160** does receive a second signal from the second proximity sensor **146** while the electronic counter **160** is primed by the first signal from the first proximity sensor **144**, then the electronic counter **160** increments the rep count by one and the electronic counter **160** removes itself from the primed state. When the electronic counter **160** is not in the primed state, the electronic counter **160** will not increment the rep count, even if the electronic counter **160** receives a second signal from the second proximity sensor **146**. A first signal from the first proximity sensor **144** is required to enter the electronic counter **160** into the primed state again.

[0041] It can be seen that the electronic counter **160** will only increment the rep count by one when the first proximity sensor **144** sends its first signal to prime the electronic counter **160**, and then the second proximity sensor **146** sends its second signal to the electronic counter **160** while the electronic counter **160** is still in the primed state. Once the electronic counter **160** receives the second signal from the second proximity sensor **146**, the electronic counter **160** is removed from the primed state. Therefore, the second proximity sensor **146** can send the second signal to the electronic counter **160** multiple times in a row, but the electronic counter **160** will only increment the rep count if the electronic counter **160** is in the primed state, which only happens when the electronic counter **160** receives a first signal from the first proximity sensor **144**.

[0042] The embodiment as described prevents the electronic counter **160** from registering multiple rep counts even if the electronic counter **160** receives multiple signals from the second proximity sensor **146**, as would occur when the movable component **130** travels only small distances around the position of the second proximity sensor **146**. To count a rep, the movable component must move through the first position (where the first proximity sensor **144** is located) up to the second position (where the second proximity sensor **146** is located). To count any additional reps, the movable component must first move back along the path to the position of the first proximity sensor **144** to prime the electronic counter **160** again before the electronic counter **160** will allow a second signal from the second proximity sensor **146** to increase the rep count. In this way, the locations of the first proximity sensor **144** and the second proximity sensor **146** force the movable component **130** to travel through a minimum acceptable distance before allowing the electronic counter **160** to increment the rep count.

[0043] FIG. **2** is a flow chart diagram showing the operation of a rep counter apparatus of the present invention. The electronic counter **160** portion of the rep counter apparatus starts out in a shut down mode. Once the movable component **130** is moved and one of a plurality of proximity sensors detects the motion of the movable component **130**, the signal from the proximity sensor triggers the electronic counter **160** to exit the shut down mode, and to activate a timer **168** to start measuring accrued time of operation. If the first proximity sensor **144** is triggered, the electronic counter **160** is primed to await a second signal from the second proximity sensor **146**. If the second proximity sensor **146** is then triggered, the electronic counter **160** then adds one rep to the rep count, the electronic counter **160** is no longer primed to respond to a signal from the second proximity sensor **146**, and a display device **170** displays the current rep count and the accrued time. The process then looks for the first signal from the first proximity sensor **144** to prime the electronic counter **160** again, and the process starts over.

[0044] The rep counter apparatus may also be set up to display rest time. In this mode, the display device **170** would cease to display the accrued time of usage, and after a preset period of time of inactivity, for example 5 seconds of time during which the electronic counter **160** does not receive a signal from either the first proximity sensor **144** or the second proximity sensor **146**, the display device **170** would start to display rest time.

[0045] In one embodiment, the rep counter apparatus could utilize a third proximity sensor, called the start proximity sensor **142**, positioned at a start position along the path. In this embodiment, the movable component **130** would be brought back to its start position, causing the start proximity sensor **142** to send a start position signal to the electronic counter **130**. After the electronic counter **130** had received the start position signal for a preset period of time, for example 5 seconds, the electronic counter **130** would assume that the operator was taking a rest break, and the display device would cease to display the accrued time, and would start to display the rest time (the period of time since the movable component **130** had been positioned at the start position).

[0046] In another embodiment, there would be no need for a third proximity sensor. With only a first proximity sensor **144** and a second proximity sensor **146**, a similar rest time could be calculated. In this embodiment, the movable component **130** would be brought back to its start position, or any other position that did not cause the first proximity sensor **144** or the second proximity sensor **146** to send a signal to the electronic counter **160**. After the electronic counter **130** had waited for a preset period of time without any signals from either the first proximity sensor **144** or the second proximity sensor **146**, for example 5 seconds, the electronic counter **130** would assume that the operator was taking a rest break, and the display device would cease to display the accrued time, and would start to display the rest time (the period of time since the movable component **130** had ceased to receive any signals from either the first proximity sensor **144** or the second proximity sensor **146**).

[0047] Regardless of how rest time is calculated, the rep counter apparatus could continue to show rest time on the display device for a preset target value of rest time, for example, two minutes. If a first signal from the first proximity sensor **144** or a second signal from a second proximity sensor **146** was received by the electronic counter **160** before the preset target value of rest time was reached, the electronic counter **160** would switch back to accrued time, and the display device would cease to display the rest time and would start to display accrued time. If, however, the rest time reached the preset target value of rest time, for example, two minutes, without the electronic counter **160** receiving a first signal from the first proximity sensor **144** or a second signal from a second proximity sensor **146**, then the rep count would be added to the total reps stored in the memory storage device **165**, the timer **168** would clear the rest time and the accrued time, the electronic counter **160** would assume that the operator was done with his or her exercise session, the electronic counter **160** would start over from 0 reps (to prepare for a new exercise session), and the electronic counter would enter shut down mode.

[0048] Shut down mode is a useful mode because it minimizes power usage by the rep counter apparatus. In addition, it resets the values of rep count, the accrued time, and the rest time to 0. This is convenient to allow multiple operators to use the same piece of strength exercise equipment. An operator using an exercise apparatus does not typically want to know any information about the exercise session of a different operator. By clearing the rep count, the accrued time, and the rest time upon entering shut down mode, the electronic counter **160** displays to an operator only information relevant to that operator.

[0049] However, unlike an operator, an owner of a piece of strength exercise equipment may want to have more information available to them. The owner of the exercise apparatus may not want all of this usage information deleted after an exercise session, but may want to keep some of this usage information in the memory storage device **165**. It is beneficial to an owner to be able to review exercise machine usage data.

[0050] For owners of strength equipment, it is beneficial to know the total usage of each piece of strength equipment in the possession of the owner. Total usage can be measured by the number of hours of use of a piece of strength equipment, and/or the total accumulated number of repetitions acquired on the strength equipment. Ideally, both the total numbers of hours of use, and the total accumulated number of repetitions would be recorded, to allow an owner to make informed decisions about the exercise equipment.

[0051] If an owner can know the total usage for each piece of strength equipment in his/her possession, the owner can make better decisions. For example, the owner can use the total usage information to schedule preventative maintenance on equipment that has a high total usage. The owner can determine if a certain piece of exercise equipment is highly used, and potentially purchase more of the same type of exercise equipment, or, conversely, can determine that a certain piece of exercise equipment is underutilized, and make decisions based on this information. The owner can look at usage data over time, and determine trends. Therefore, it is important for a monitoring device coupled to strength equipment to have the ability to record the total number accumulated number of repetitions acquired on the strength equipment, as well as the total number of hours of accumulated usage.

[0052] The memory storage device **165** in the present invention stores a total accrued time of usage, as well as a total number of reps performed on the weight tower **100** of the exercise apparatus. The present invention is configured so that this information can be retrieved from the memory storage device **165** and displayed on the display device **170** by entering a usage mode, not typically accessible by the operator of the exercise apparatus.

[0053] In one embodiment, the usage mode could be entered by holding a magnet up to the magnetic reed switch **162** (see FIG. **9**) on the electronic counter **160** to instruct the electronic counter to enter usage mode, allowing the display device **170** to display total accrued time of usage and/or total number of reps performed on the weight tower **100**. By removing the magnet, the electronic counter **160** would leave usage mode, allowing the display device **170** to display information relevant to a particular exercise session. This feature provides exercise session information to the operator, and total usage information for the weight tower **100** of the exercise apparatus to the owner of the exercise apparatus.

[0054] Referring to FIG. **3**, a close up view of the sensor track **140**, the start position sensor **142**, the first proximity sensor **144**, and the second proximity sensor **146** is shown. The position of the first proximity sensor **144** may be adjusted to set the first position along the path, and the position of the second proximity sensor **146** may be adjusted to set the second position along the path. Different exercise machines, such as leg press machines, or arm curl strength machines, require different travel distances for the movable component **130**, because each exercise is different, requiring a different range of motion for the exercise. The sensor track **140** allows for quick and easy repositioning of the plurality of proximity sensors so that a single style of weight tower **100** may be configured for use with many different exercise apparatus. While any one weight tower **100** might only be used with a single exercise apparatus, the modular nature of the weight tower **100** allows a first weight tower **100** to be joined to a first exercise apparatus, and a second identical weight tower **100** to be joined to a different, second exercise apparatus.

[0055] The movable component **130** is shown in proximity to the start position sensor **142**, but as the movable component **130** is guided by the guide member **120** up and down the path, the movable component **130** may move away from the start position sensor **142**, and may move near the first proximity sensor **144**, the second proximity sensor **146**, or away from all of the proximity sensors. The guide member **120** will always constrain the movable component **130** to travel along the path, and the proximity sensors and the sensor track **140** are located along the same path.

[0056] FIGS. **4-8** illustrate the weight tower **100** of the strength exercise apparatus with the movable component **130** in various locations. For simplicity, the weight plates **115** are shown to remain stationary, but the selector **118** may be repositioned to select any number of the weight plates **115**, or all of the weight plates **115**, or none of the weight plates **115**. The weight plates **115** that are selected or engaged by the selector **118** would travel with the movable component **130** up and down along the path.

[0057] FIG. **4** illustrates the weight tower **100** of a strength exercise apparatus when the movable component **130** is positioned in the start position. The movable component **130** is shown in proximity to the start position sensor **142**. With the movable component **130** in this position, the start position sensor **142** would send a start position signal to the electronic counter **160**. Neither the first proximity sensor **144** nor the second proximity sensor **146** would send a signal to the electronic counter **160** because the movable component **130** is not in proximity to either of these proximity sensors.

[0058] FIG. **5** illustrates the weight tower **100** of a strength exercise apparatus when the movable component **130** is positioned between the start position and the first position. The movable component **130** is shown near the first proximity sensor **144**, but not near enough for the first proximity sensor **144** to send a first signal to the electronic counter **160**. With the movable component **130** in this position, none of the proximity sensors, including the start position sensor **142**, the first proximity sensor **144**, and the second proximity sensor **146** would send a signal to the electronic counter **160** because the movable component **130** is not in proximity to any of these proximity sensors.

[0059] FIG. **6** illustrates the weight tower **100** of a strength exercise apparatus when the movable component **130** is positioned at the first position. The movable component **130** is shown in proximity to the first proximity sensor **144**. With the movable component **130** in this position, the first proximity sensor **144** would send a first signal to the electronic counter **160**. This first signal would prime the electronic counter **160** to await a second signal from the second proximity sensor **146**, but would not cause the electronic counter **160** to increment the rep count. Neither the start position sensor **142** nor the second proximity sensor **146** would send a signal to the electronic counter **160** because the movable component **130** is not in proximity to either of these proximity sensors.

[0060] FIG. **7** illustrates the weight tower **100** of a strength exercise apparatus when the movable component **130** is positioned at the second position. The movable component **130** is shown in proximity to the second proximity sensor **146**. With the movable component **130** in this position, the second proximity sensor **146** would send a second signal to the electronic counter **160**. Assuming the electronic counter **160** was in a primed state from receiving an earlier first signal from the first proximity sensor **144**, the second signal from the second proximity sensor **146** would cause the electronic counter **160** to increment the rep count, and it would cause the electronic counter **160** to no longer be primed to receive additional signals from the second proximity sensor **146**. Any additional signals from the second proximity sensor **146** would be ignored by the electronic counter **160** and would not cause the electronic counter **160** to increment the rep count until the electronic counter **160** is once again primed by a signal from the first proximity sensor **144**. Neither the start position sensor **142** nor the first proximity sensor **144** would send a signal to the electronic counter **160** because the movable component **130** is not in proximity to either of these proximity sensors.

[0061] FIG. **8** illustrates the weight tower **100** of a strength exercise apparatus when the movable component **130** is positioned above the second position. The movable component **130** is free to travel along the path beyond the second position, but the movable component **130** must reverse direction along the path and return to the first position or below (see FIGS. **5** and **6**) before the electronic counter **160** will be primed to receive additional signals from the second proximity sensor **146**. In other words, the electronic counter **160** will not increment the rep count again unless the movable component first moves downward to the first position or below (see FIGS. **5** and **6**) and then moves upward again to reach the second position (see FIG. **7**). In this way, the movable component **130** is required to cycle back and forth over a minimum acceptable distance (the distance between the positions of the first proximity sensor **144** and the second proximity sensor **146**) for the electronic counter **160** to continue to increment the rep count for each good rep. If the movable component **130** does not cycle back and forth between the first position and the second position, the rep is an incomplete rep, and the electronic counter **160** will not increment the rep count.

[0062] FIG. **9** illustrates the electronic counter **160**. The electronic counter **160** in this embodiment includes a magnetic reed switch **162**, a battery **164**, a memory storage device **165**, a timer **168**, and a display device **170**.

[0063] As shown in FIG. **9**, the display device **170** is designed to display a two-digit number representing the rep count, and a three-digit number representing the time, either accrued time or rest time. However, the display could be set up very differently to display the same information in a different format, or to display additional information. The display illustrated in FIG. **9** is presented for illustrative purposes only, and is not meant to limit the invention in any way.

[0064] Accordingly, the foregoing figures and description provide a number of ways in which an apparatus for counting repetitions of an exercise device could be configured. The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes that come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. An apparatus for counting repetitions of an exercise device, comprising:

a frame comprising at least one guide member;

a movable component configured to be moved in response to a mechanical stimulus generated during repetition movement, the movable component configured to travel along a path having a start position, a first position, and a second position, wherein the movable component of the exercise device is guided along the path by the at least one guide member, and wherein the movable component is located at the start position before the mechanical stimulus is generated, and the movable component returns to the start position after the mechanical stimulus has ceased to be generated;

first and second proximity sensors coupled to the frame, the first proximity sensor operably coupled to the movable component to transmit a first signal when the movable component is proximate the first position, and the second proximity sensor operably coupled to the movable component to transmit a second signal when the movable component is proximate the second position;

an electronic counter having a memory storage device for storing a rep count representing the number of repetitions of the movable component moving along the path, the electronic counter configured to receive the first and second signals, wherein the electronic counter is configured such that receipt of the second signal causes the electronic counter to increment the rep count by one when the second signal is preceded by receipt of the first signal; and

a display device in communication with the electronic counter, the display device configured to display the rep count.

2. The apparatus of claim **1**, wherein the electronic counter is configured such that receipt of the first signal does not increment the rep count.

3. The apparatus of claim 1, wherein the electronic counter is configured such that receipt of the second signal alone does not increment the rep count.

4. The apparatus of claim 1, wherein the electronic counter is configured to increase the rep count by one when the movable component is moved along the path past the first position and proximate the second position.

5. The apparatus of claim 1, wherein the electronic counter is configured to increase the rep count by one when the movable component is moved along the path past the first position and proximate the second position, and wherein the electronic counter is configured to prevent any further increase of the rep count until the movable component is moved back along the path to a position in proximity with the first position.

6. The apparatus of claim 1, wherein the location of the first proximity sensor defines the first position and the location of the second proximity sensor defines the second position, the second position located above the first position.

7. The apparatus of claim 1, and further comprising a timer in communication with the electronic counter and the display device.

8. The apparatus of claim 1, and further comprising a timer in communication with the electronic counter and the display device, wherein the timer is configured to start measuring accrued time when at least one of the first signal and the second signal is received by the electronic counter, and wherein the timer is configured to start measuring rest time if the first signal is not received by the electronic counter within a preset period of time, and wherein the display device is configured to display at least one of the accrued time and the rest time.

9. The apparatus of claim 8, wherein the timer is configured to enter a shut-down mode if the rest time reaches a preset target value, wherein the rep count, the accrued time and the rest time are reset to zero when the timer enters the shut-down mode.

10. The apparatus of claim 1, and further comprising a timer in communication with the electronic counter and the display device, wherein the timer is configured to start measuring accrued time when at least one of the first signal and the second signal is received by the electronic counter, and wherein the timer is configured to stop measuring accrued time, reset the accrued time to zero, and start measuring rest time if the first signal is not received by the electronic counter within a preset period of time, and wherein the display device is configured to display at least one of the accrued time and the rest time.

11. The apparatus of claim 1, wherein the electronic counter adds the rep count of the electronic counter to a total number of repetitions, and wherein the electronic counter stores in the memory storage device the total number of repetitions of the exercise device.

12. The apparatus of claim 1, and further comprising a timer in communication with the electronic counter and the display device, wherein the timer is configured to start measuring accrued time when at least one of the first signal and the second signal is received by the electronic counter, and wherein the electronic counter adds the accrued time to a total accrued time, and wherein the electronic counter stores in the memory storage device the total accrued time of the exercise device.

13. The apparatus of claim 1, and further comprising a timer in communication with the electronic counter and the display device, wherein the timer is configured to start measuring accrued time when at least one of the first signal and the second signal is received by the electronic counter, and wherein the electronic counter adds the accrued time to a total accrued time, and wherein the electronic counter adds the rep count of the electronic counter to a total number of repetitions, and wherein the electronic counter stores in the memory storage device the total number of repetitions of the exercise device and the total accrued time of the exercise device, and wherein the display device is configured to display at least one of the total accrued time of the exercise device and the total number of repetitions of the exercise device.

14. An apparatus for counting repetitions of an exercise device, comprising:

a frame comprising at least one guide member;

a movable component configured to be moved in response to a mechanical stimulus generated during repetition movement, the movable component configured to travel along a path having a start position, a first position, and a second position, wherein the movable component of the exercise device is guided along the path by the at least one guide member, and wherein the movable component is located at the start position before the mechanical stimulus is generated, and the movable component returns to the start position after the mechanical stimulus has ceased to be generated;

first and second proximity sensors coupled to the frame, the first proximity sensor operably coupled to the movable component to transmit a first signal when the movable component is proximate the first position, and the second proximity sensor operably coupled to the movable component to transmit a second signal when the movable component is proximate the second position;

a start position proximity sensor coupled to the frame, the start position proximity sensor operably coupled to the movable component to transmit a third signal when the movable component is proximate the start position;

an electronic counter having a memory storage device for storing a rep count representing the number of repetitions of the movable component moving along the path, the electronic counter configured to receive the first, second, and third signals, wherein the electronic counter is configured such that receipt of the second signal causes the electronic counter to increment the rep count by one when the second signal is preceded by receipt of the first signal; and

a display device in communication with the electronic counter, the display device configured to display the rep count.

15. The apparatus of claim 14, wherein the electronic counter is configured to increase the rep count by one when the movable component is moved along the path past the first position and proximate the second position, and wherein the electronic counter is configured to prevent any further increase of the rep count until the movable component is moved back along the path to a position in proximity with the first position.

16. The apparatus of claim 14, and further comprising a timer in communication with the electronic counter and the display device.

17. The apparatus of claim 14, and further comprising a timer in communication with the electronic counter and the display device, wherein the timer is configured to start mea-

suring accrued time when at least one of the first signal, the second signal, and the third signal is received by the electronic counter, and wherein the timer is configured to start measuring rest time if the third signal is received by the electronic counter for a preset period of time, and wherein the display device is configured to display at least one of the accrued time and the rest time.

18. The apparatus of claim **17**, wherein the timer is configured to enter a shut-down mode if the rest time reaches a preset target value, wherein the rep count, the accrued time and the rest time are reset to zero when the timer enters the shut-down mode.

19. The apparatus of claim **14**, and further comprising a timer in communication with the electronic counter and the display device, wherein the timer is configured to start measuring accrued time when at least one of the first signal, the second signal, and the third signal is received by the electronic counter, and wherein the timer is configured to stop measuring accrued time, reset the accrued time to zero, and start measuring rest time if the third signal is received by the electronic counter for a preset period of time, and wherein the display device is configured to display at least one of the accrued time and the rest time.

20. The apparatus of claim **14**, and further comprising a timer in communication with the electronic counter and the display device, wherein the timer is configured to start measuring accrued time when at least one of the first signal, the second signal, and the third signal is received by the electronic counter, and wherein the electronic counter adds the accrued time to a total accrued time, and wherein the electronic counter adds the rep count of the electronic counter to a total number of repetitions, and wherein the electronic counter stores in the memory storage device the total number of repetitions of the exercise device and the total accrued time of the exercise device.

* * * * *

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Dalebout et al. (43) **Pub. Date: Feb. 16, 2006**

(54) **ELLIPTICAL EXERCISE MACHINE WITH INTEGRATED ANAEROBIC EXERCISE SYSTEM**

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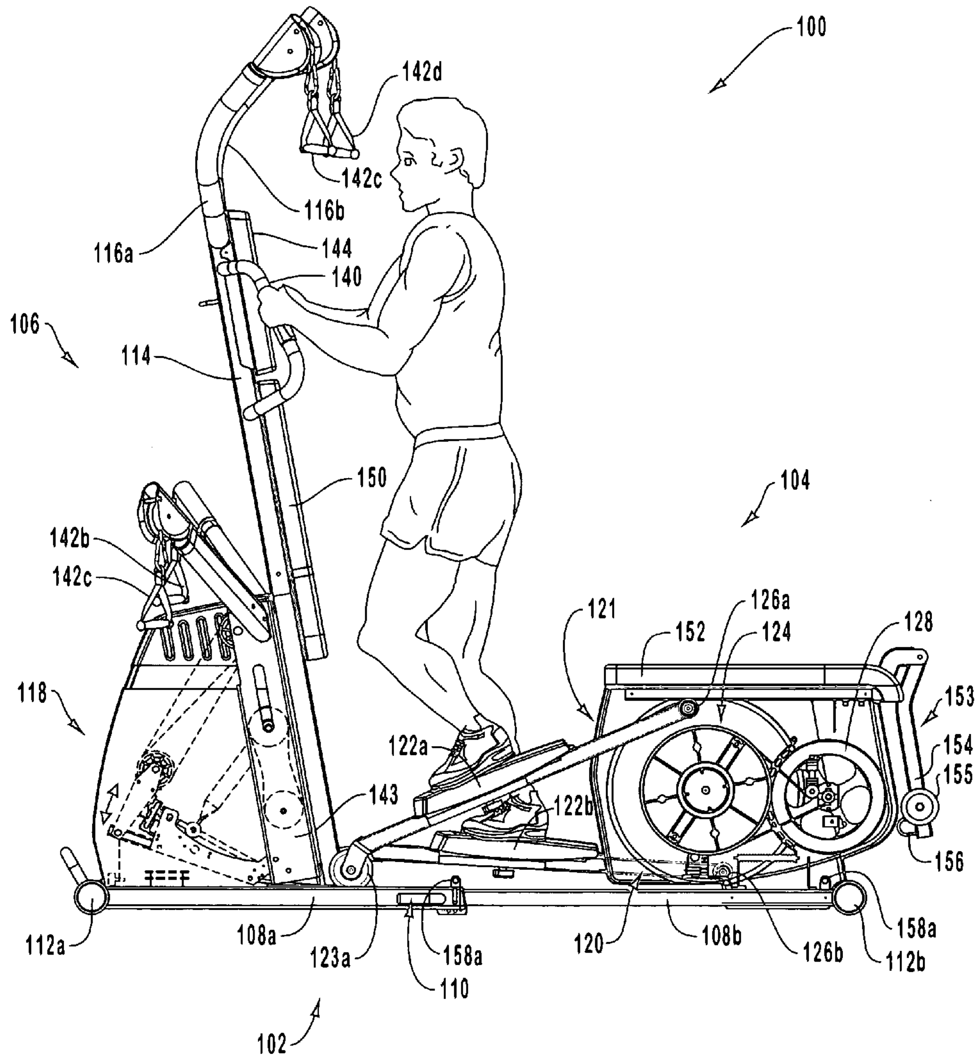
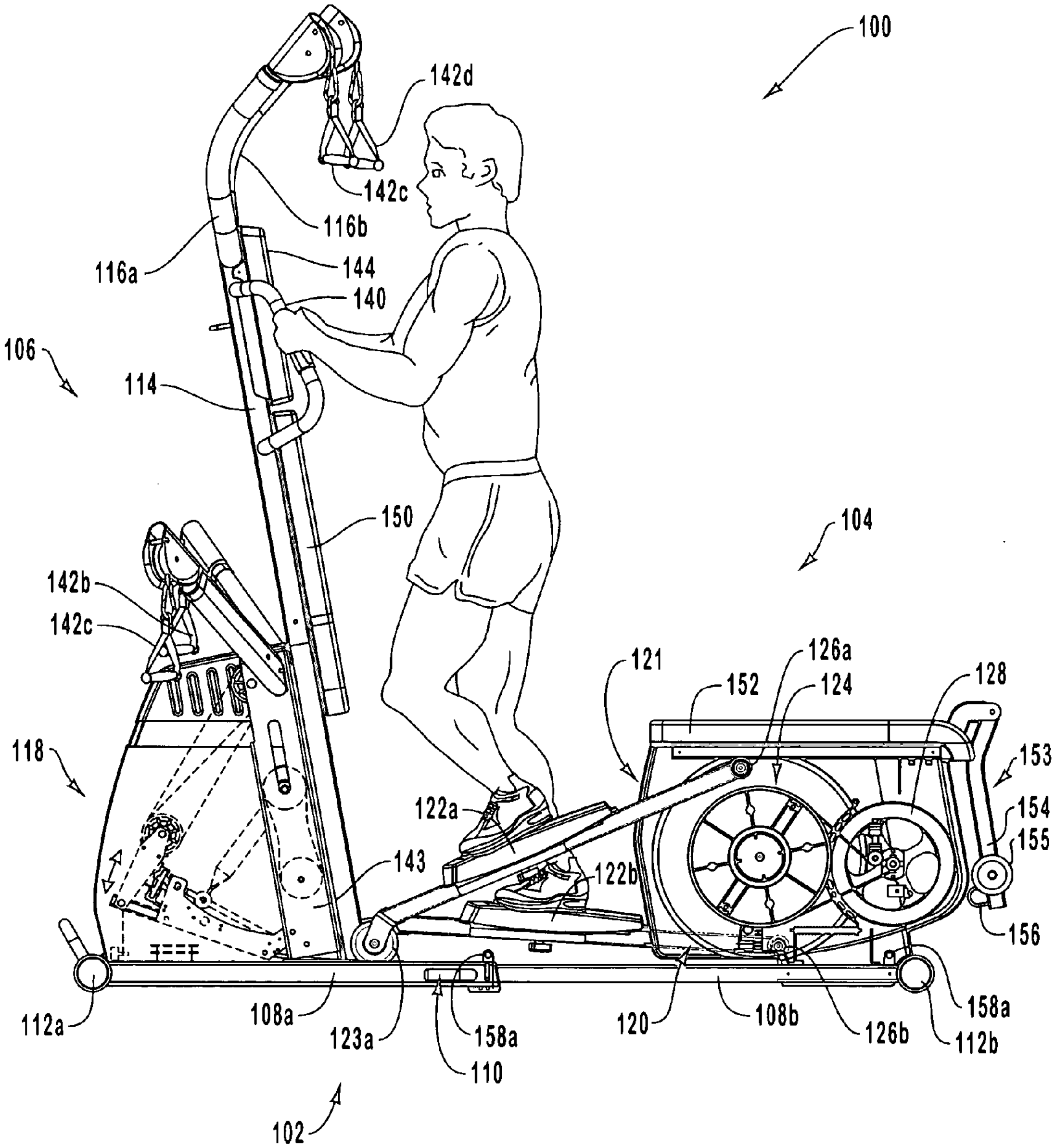
A63B 21/06 (2006.01)

(52) **U.S. Cl.** **482/52**; 482/94

(57) **ABSTRACT**

A combined anaerobic and aerobic exercise system comprises a multi-part frame, for example a telescoping frame, or a pivoting frame. The aerobic system may include an elliptical exercise device, while the anaerobic system may include a cable-based system wherein resistance is adjustable. An electronic console system at the exercise system allows a user to view progress in both anaerobic and aerobic workouts, and to send input signals that adjust anaerobic and aerobic resistance mechanisms.

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158a
112b
102

Fig. 1A

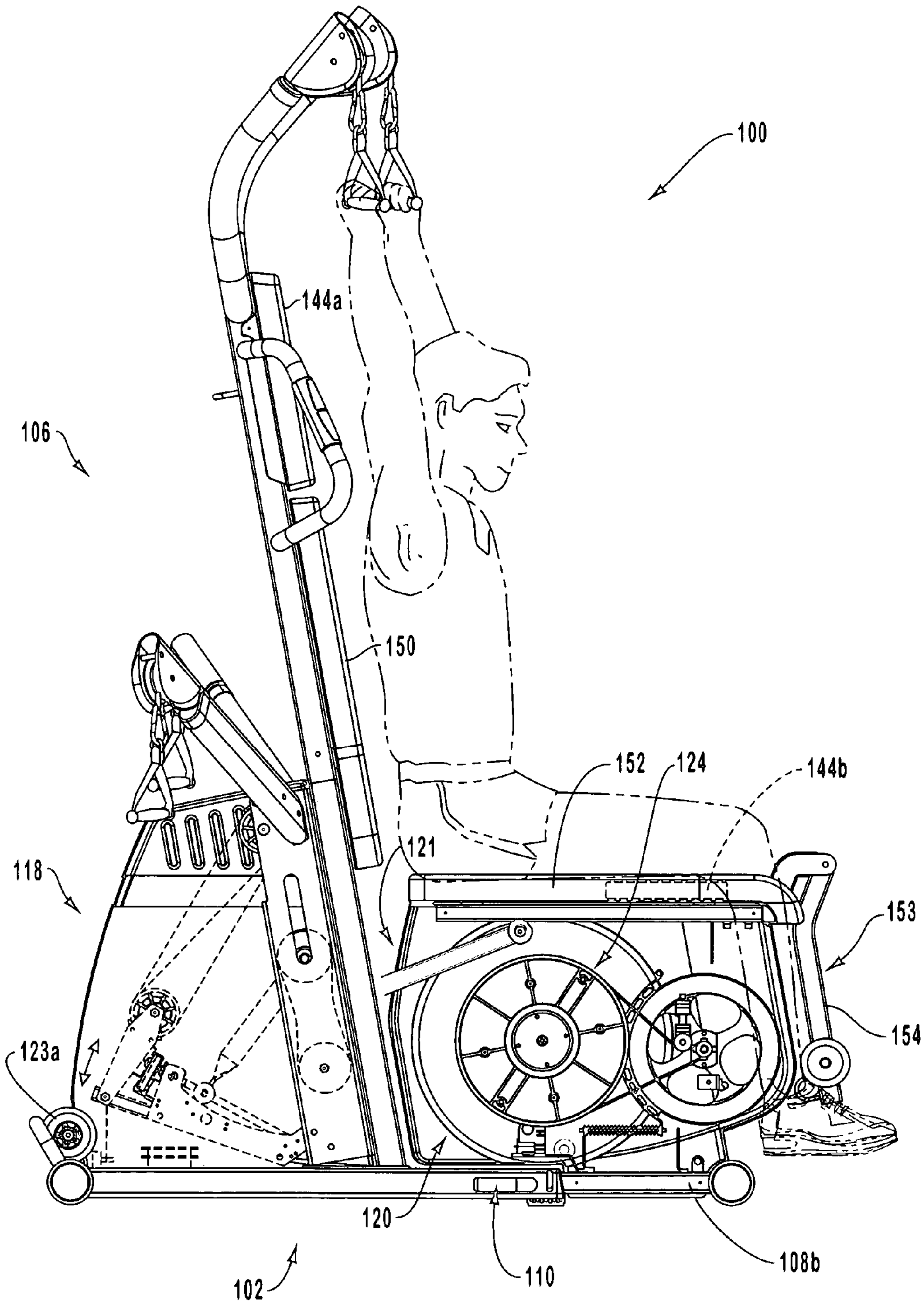
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Fig. 1B

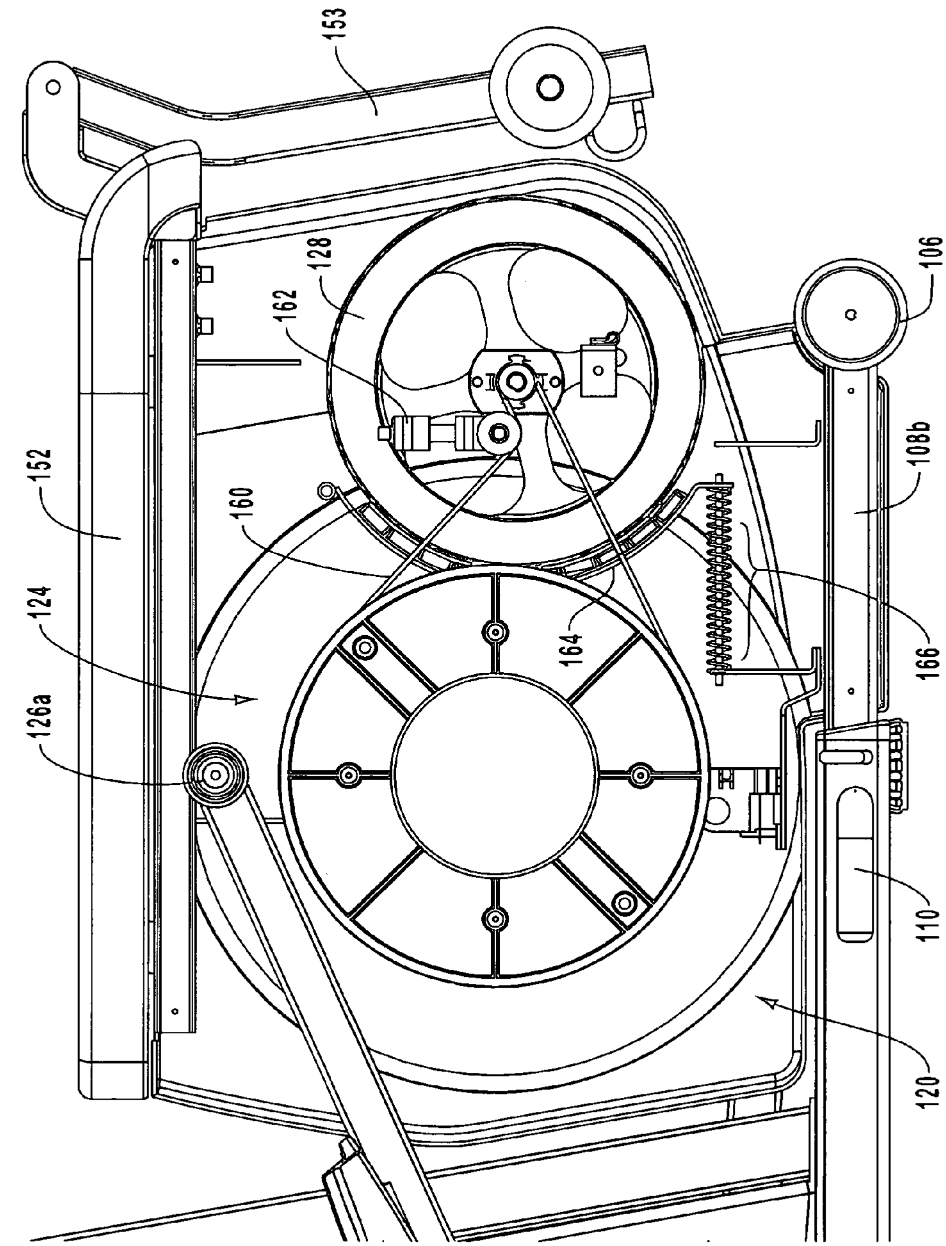


Fig. 2A

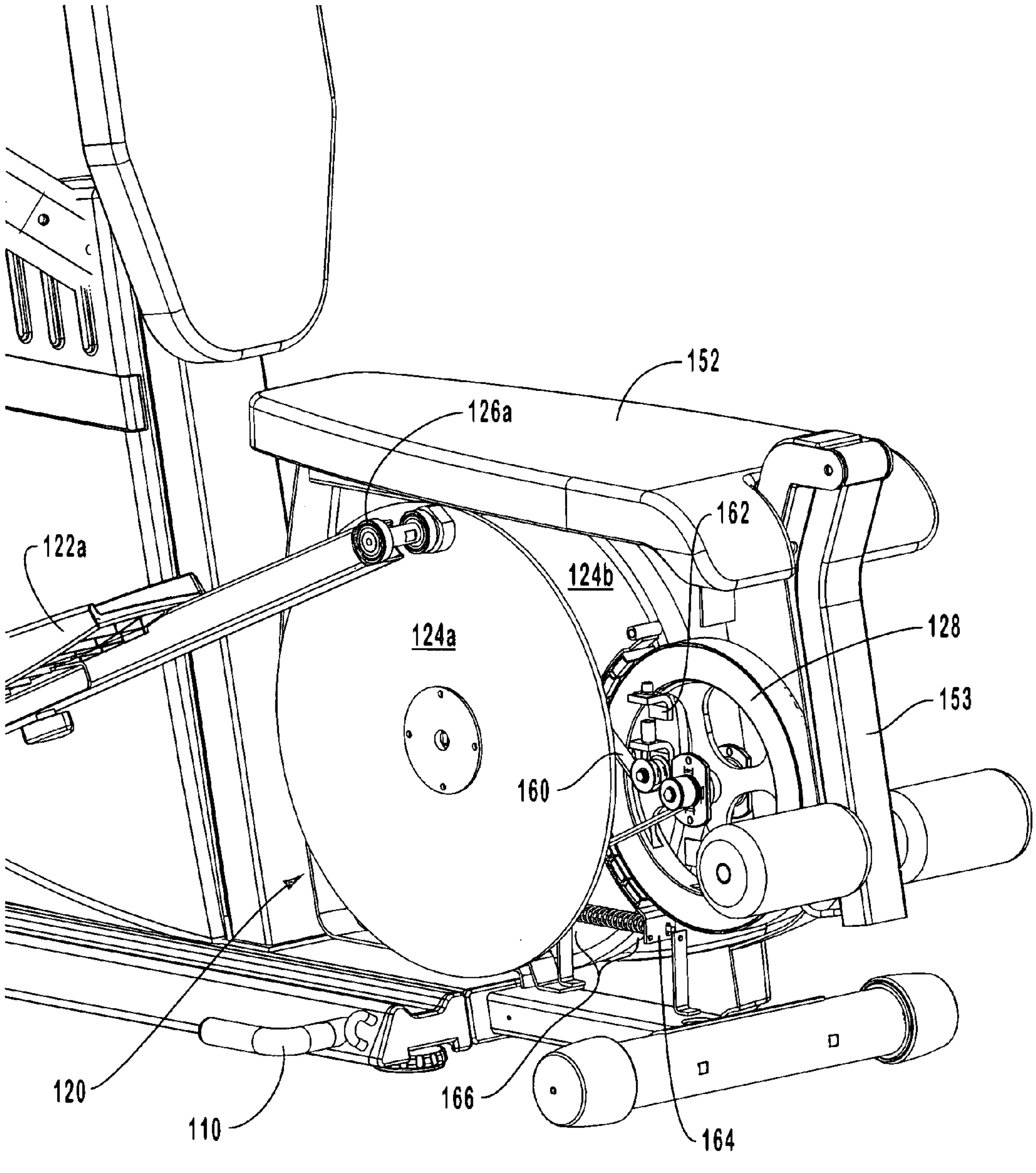


Fig. 2B

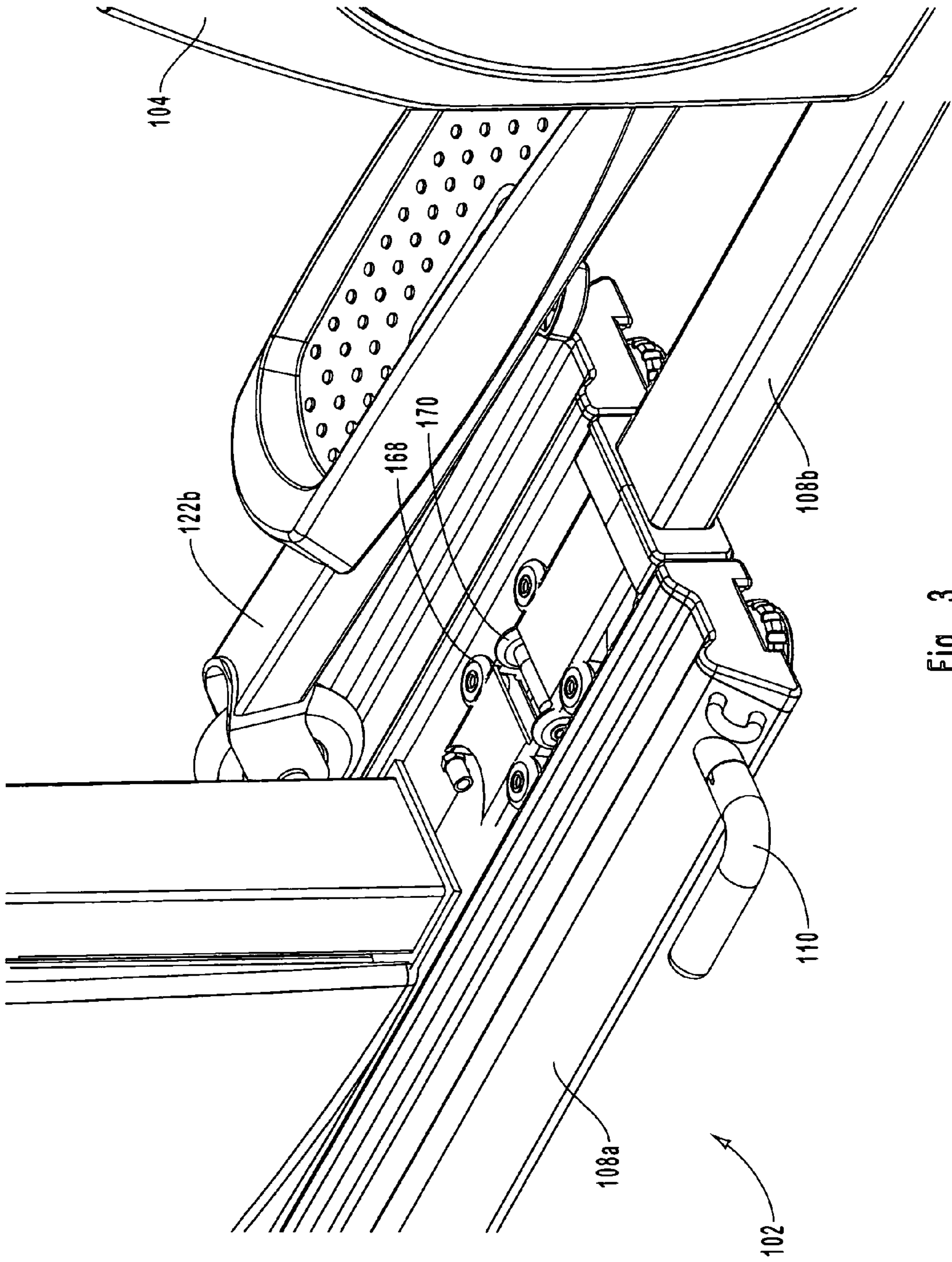


Fig. 3

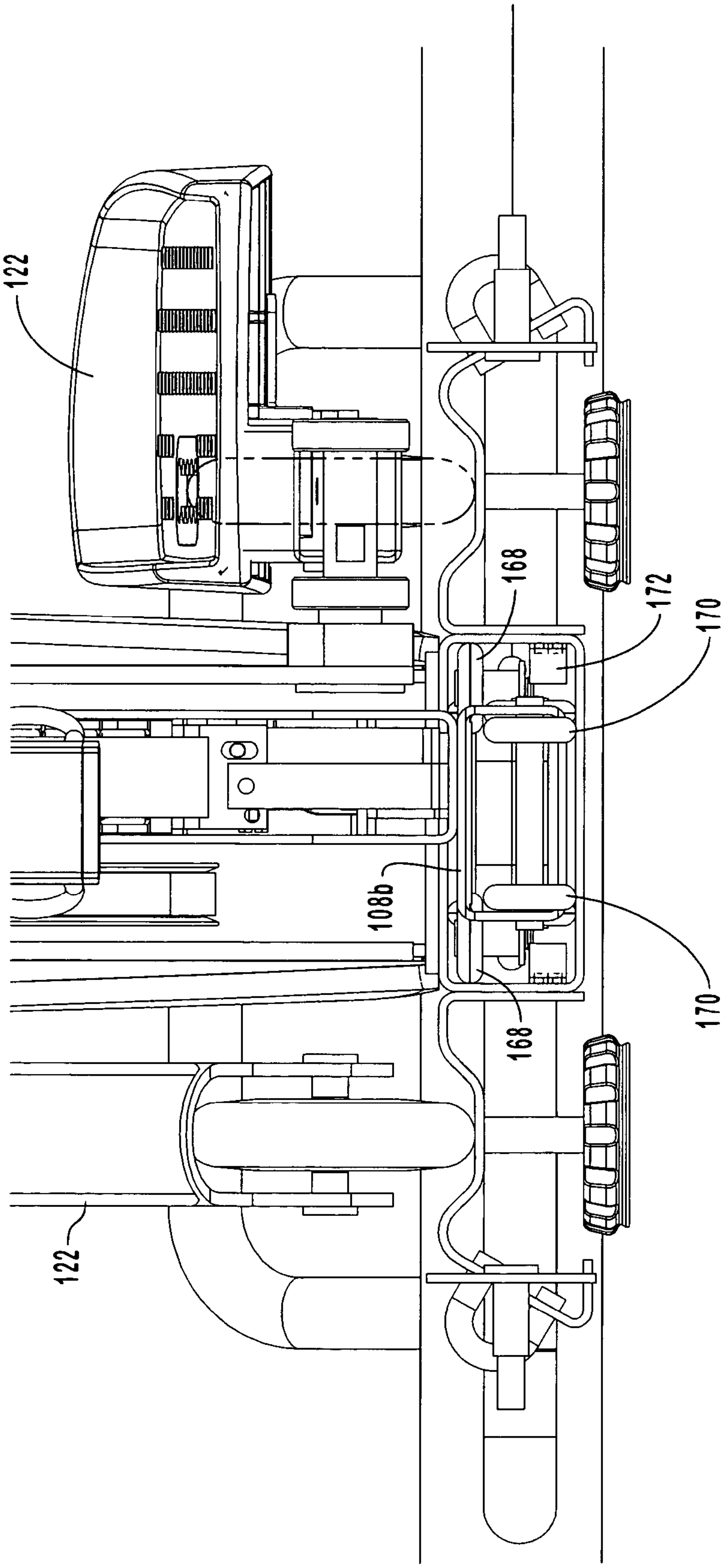


Fig. 4

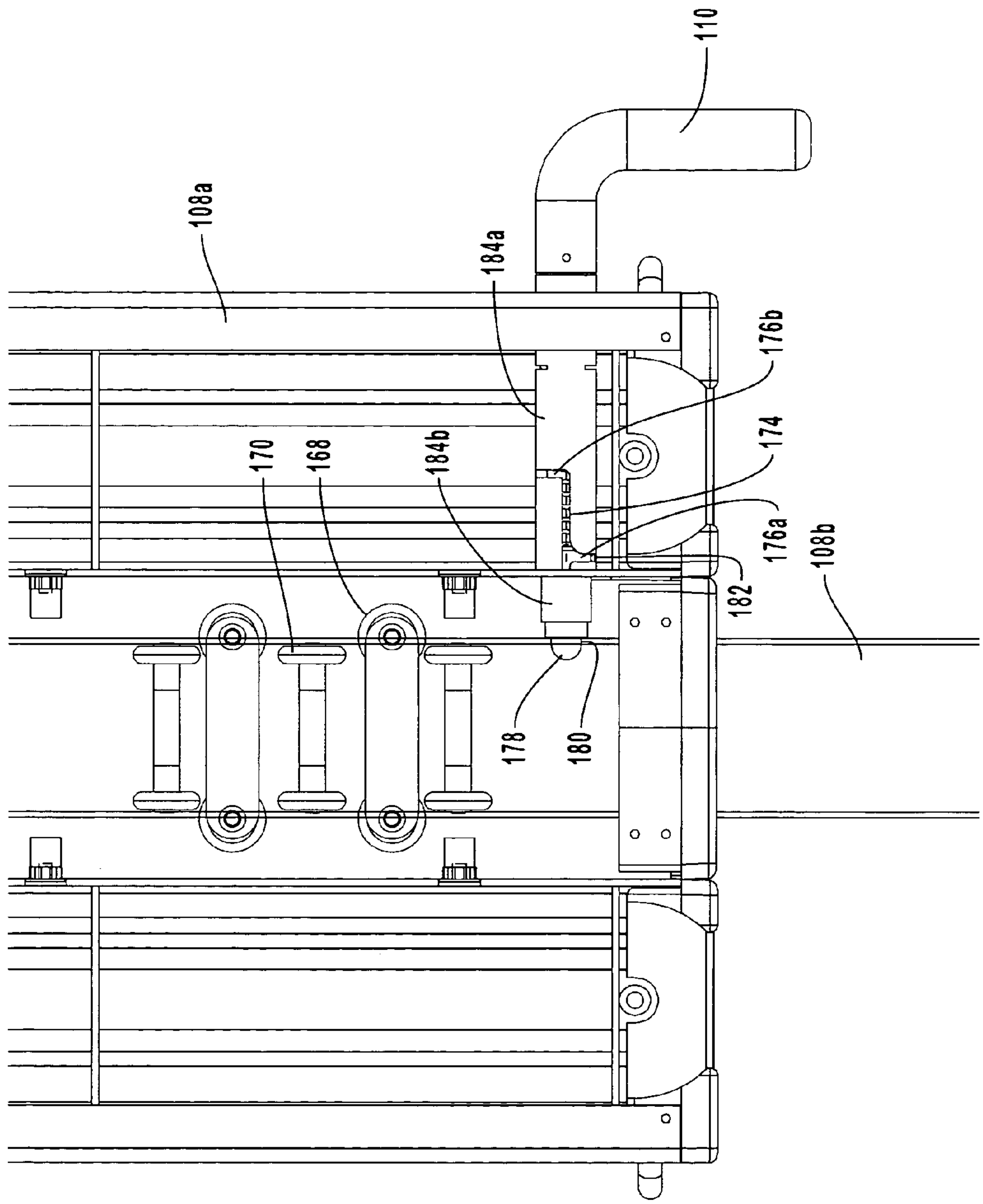


Fig. 5A

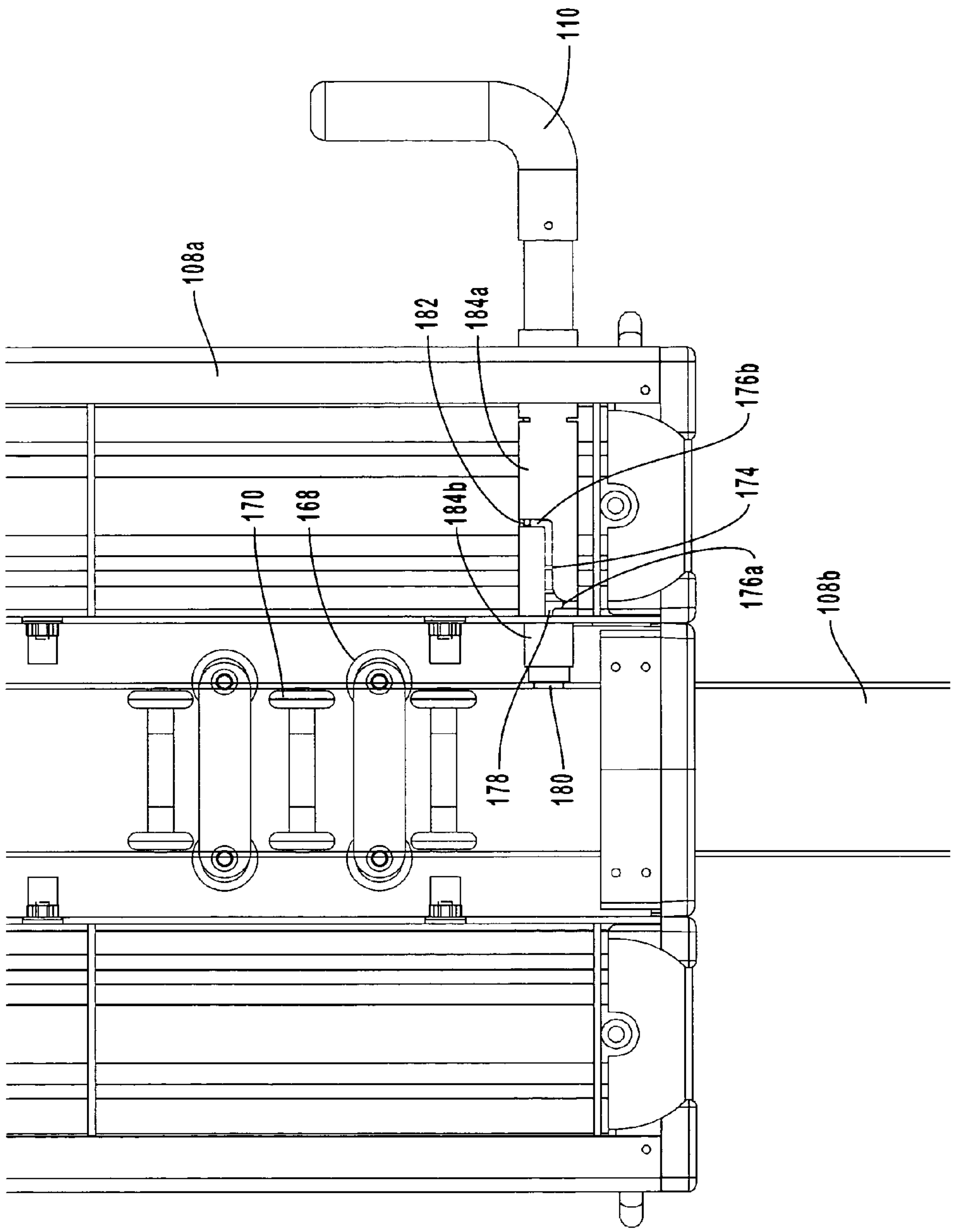


Fig. 5B

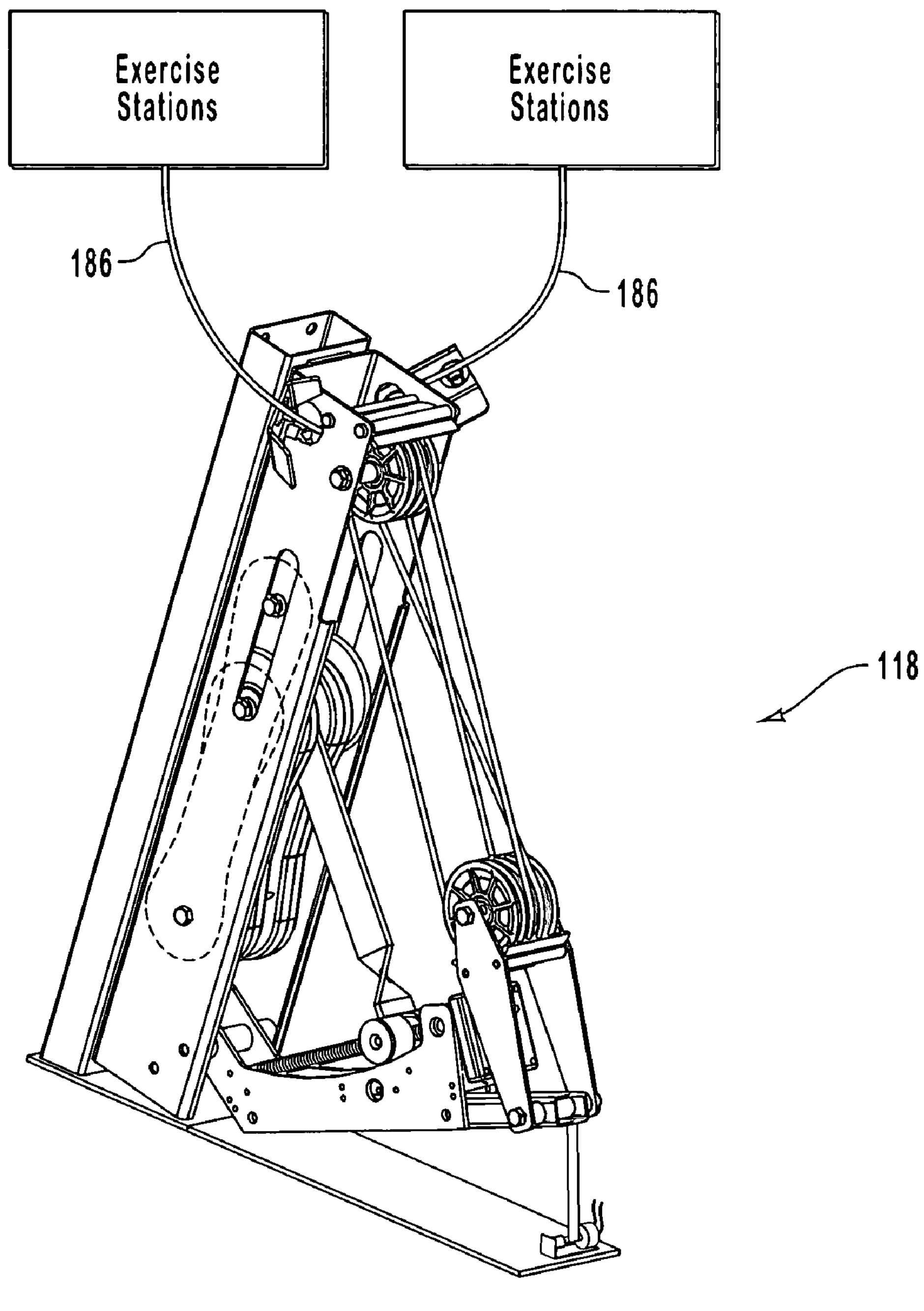
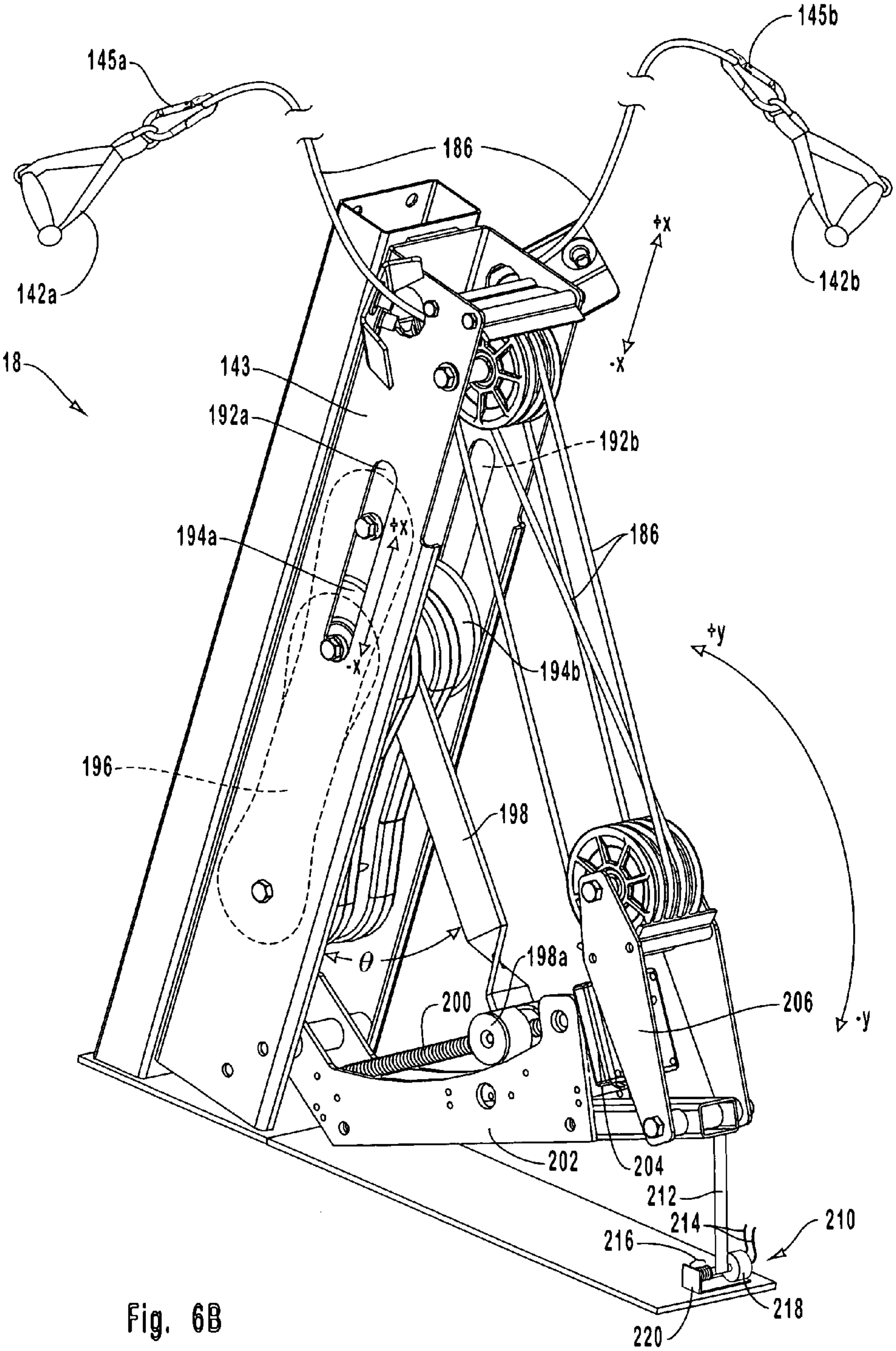


Fig. 6A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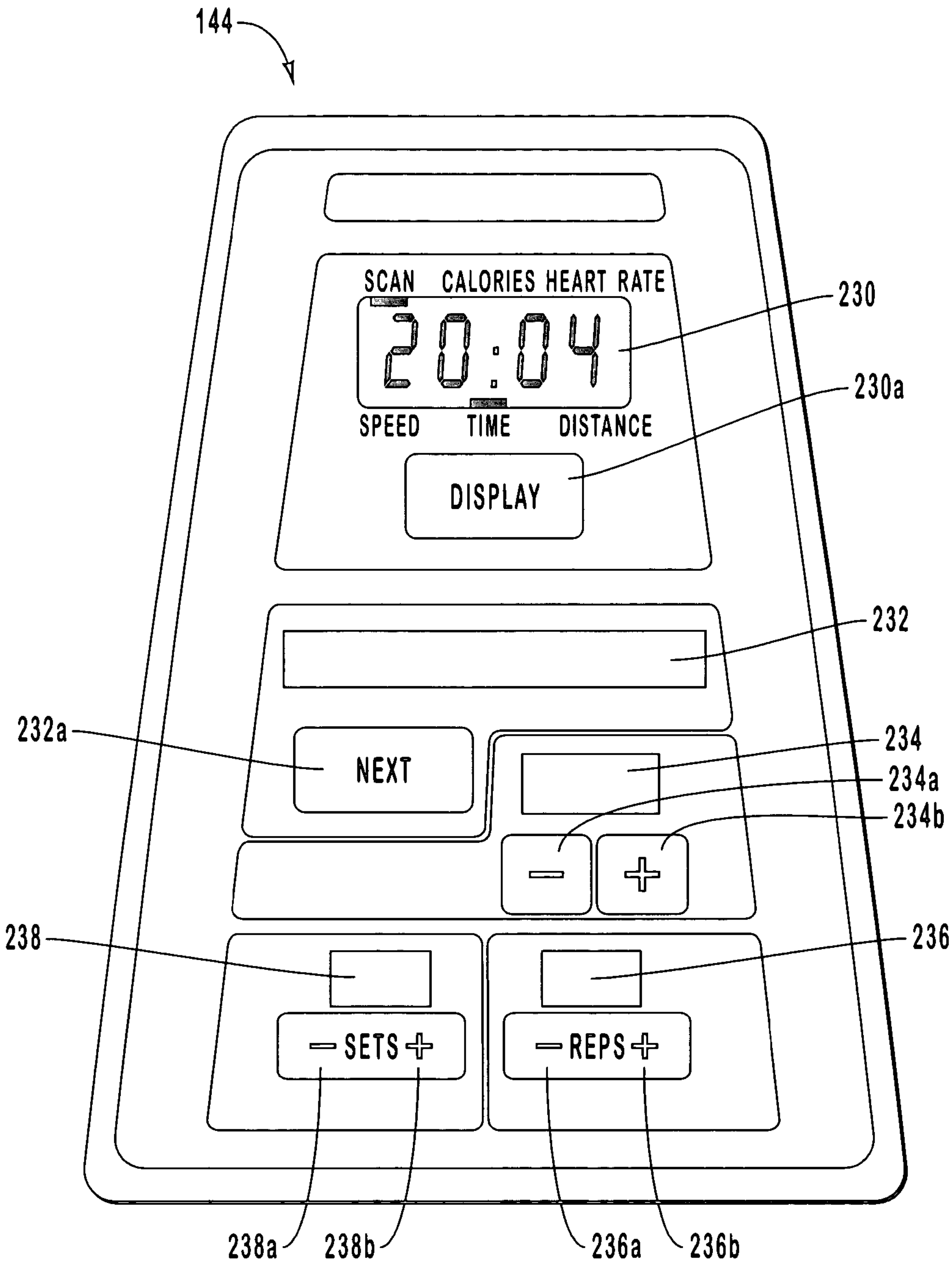
216
218
220

Fig. 6B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HEART RATE
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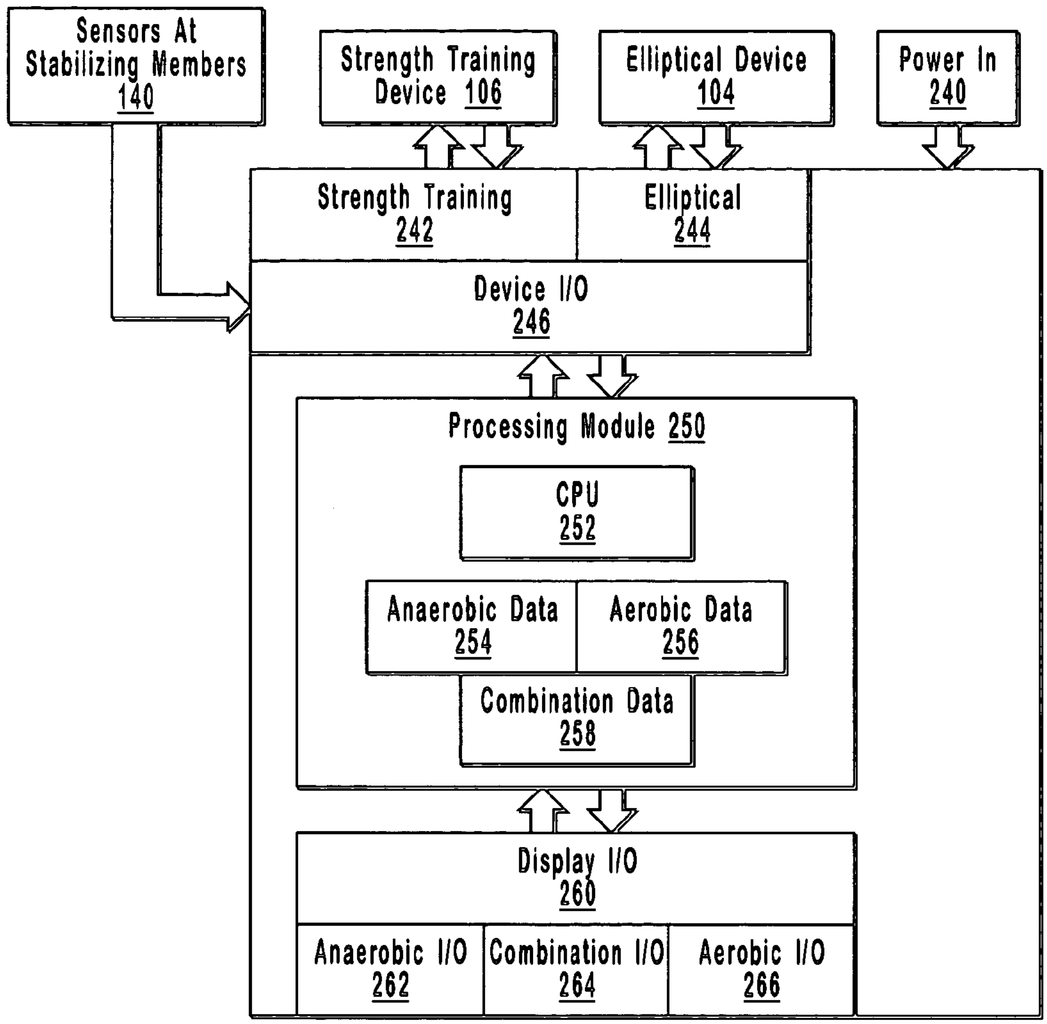
230
230a
SPEED
TIME
DISTANCE
DISPLAY
232
232a
NEXT
234
234a
234b
238
236
SETS
REPS
238a
238b
236a
236b

Fig. 7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Strength Training Device 106
Elliptical Device 104
Power In 240
Strength Training 242
Elliptical 244
Device I/O 246
Processing Module 250
CPU 252
Anaerobic Data 254
Aerobic Data 256
Combination Data 258
Display I/O 260
Anaerobic I/O 262
Combination I/O 264
Aerobic I/O 266

Fig. 8

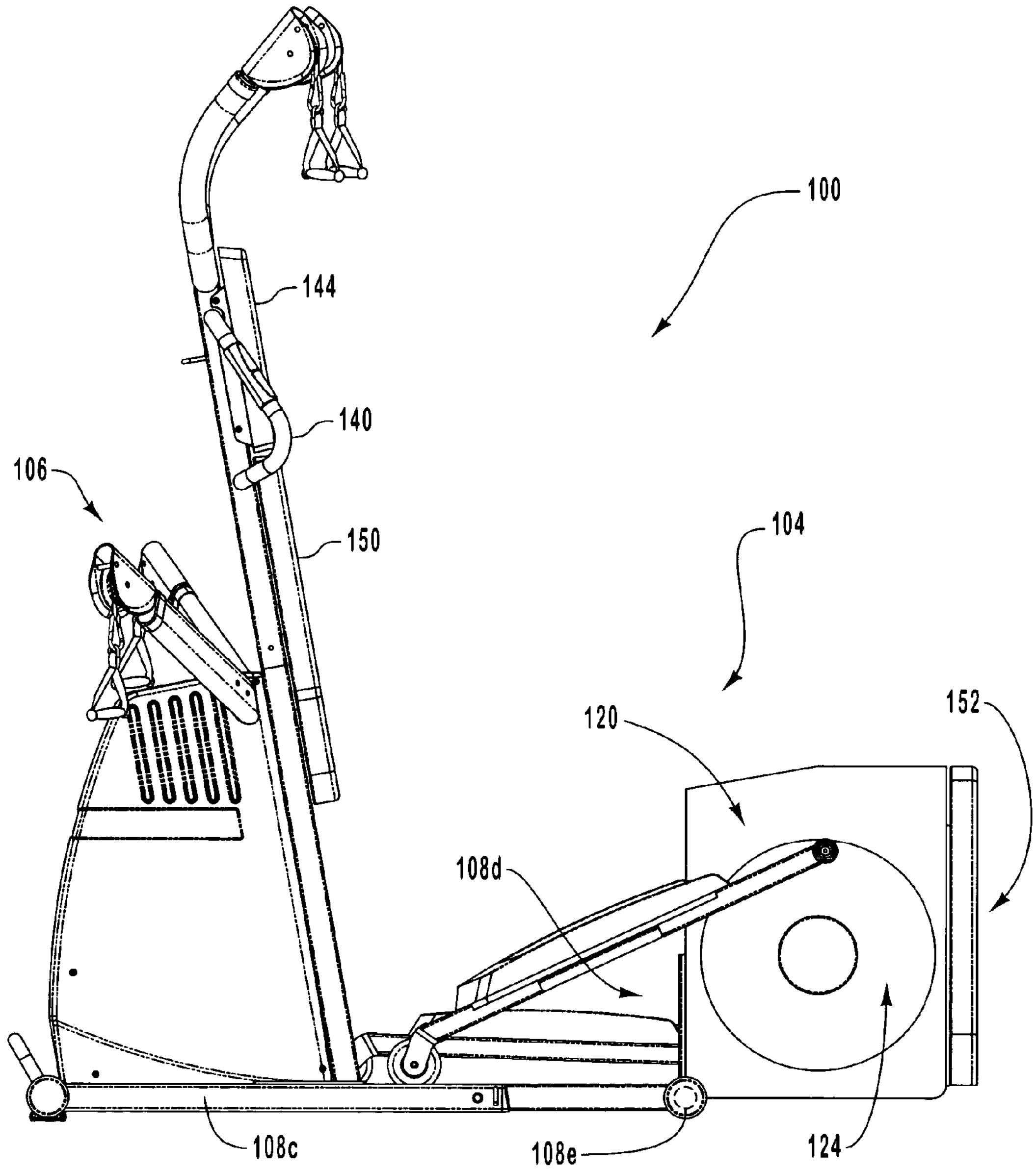

Fig. 9A

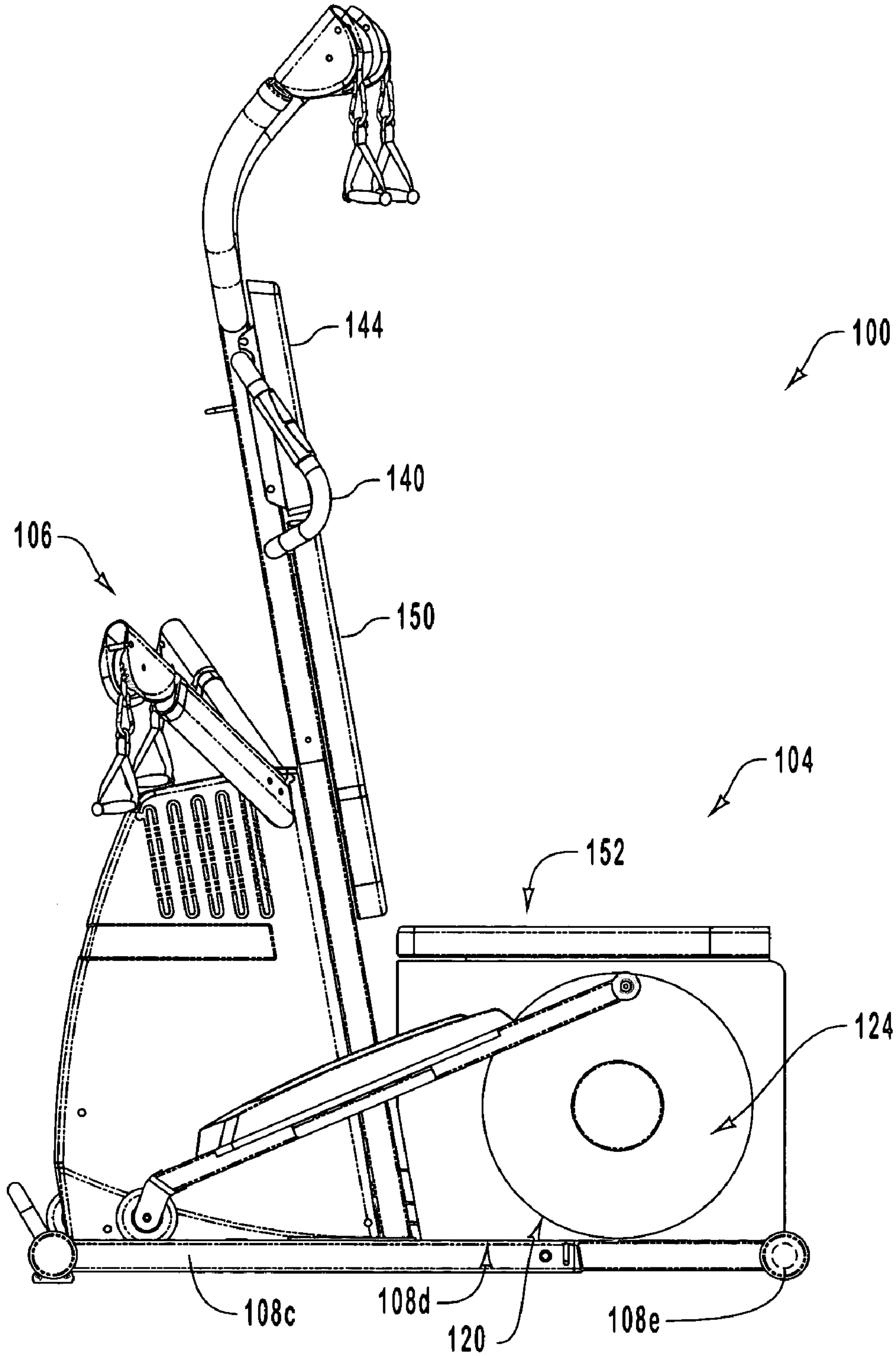

Fig. 9B

ELLIPTICAL EXERCISE MACHINE WITH INTEGRATED ANAEROBIC EXERCISE SYSTEM

BACKGROUND OF THE INVENTION

[0001] 1. The Field of the Invention

[0002] The present invention relates to exercise equipment and, more specifically, to exercise devices that provide aerobic and anaerobic activities.

[0003] 2. The Prior State of the Art

[0004] In the field of exercise equipment, a variety of devices have been developed to strengthen and condition muscles commonly used for a variety of activities, including both anaerobic and aerobic activities. Generally speaking, anaerobic activities include activities that require voluntary acting muscles to flex a significant amount during a relatively small number of repetitions, such as while engaging in strength training, e.g., with free weights or an exercise device having a cable-based resistance system. Exercise devices that enable anaerobic exercise include weight systems that provide one or more exercises based on a common resistance mechanism, such as one or more handles or bars coupled to a weight stack or other resistance mechanism via a cable-based system having one or more cables and pulleys.

[0005] By contrast, aerobic activities include activities that are designed to dramatically increase heart rate and respiration, often over an extended period of time, such as running, walking, and swimming for several minutes or more. Aerobic conditioning devices that simulate such activities have typically included treadmills, stepping machines, elliptical machines, various types of sliding machines, and so forth.

[0006] Recently, elliptical machines have proven especially popular for allowing a user to perform aerobic ambulatory exercises (e.g., walking or running) with moderate to significant intensity, while at the same time providing low impact to the user's joints.

[0007] Unfortunately, present exercise systems are generally configured for only one of anaerobic exercises and aerobic exercises, but not for both. This can create a tension for a user since both anaerobic and aerobic exercises can be important components of an exercise regimen. The tension can be heightened since anaerobic and aerobic exercise systems each separately take up a certain amount of space that a user may want to devote to other items, and since each such exercise system can be relatively expensive. Accordingly, a user may be reluctant to purchase both types of individual exercise systems due to any number of cost and space constraints.

[0008] As a result, a user may purchase only one type of exercise system, but then forego the benefits of the alternative exercise activities. This is less than ideal for users who desire to implement a complete workout regimen. Alternatively, the user may purchase only one type of exercise system, but then purchase an additional membership to a workout facility to exercise on other apparatuses in different ways. This is less than ideal at least from a convenience standpoint.

[0009] Accordingly, an advantage can be realized with exercise apparatuses that can provide the benefits of multiple types of exercises in a convenient and cost-effective manner.

BRIEF SUMMARY OF THE INVENTION

[0010] Exemplary embodiments of the present invention include systems, apparatuses, and methods that enable a user to perform anaerobic and/or aerobic activities on a compactable exercise machine. In particular, a user can move an exercise machine into a contracted position, an expanded position, or some combination therebetween, so that the user can access the exercise machine for primarily aerobic exercise, primarily anaerobic exercise, or some combination of both, as appropriate.

[0011] An exemplary exercise system may comprise an elliptical exercise device and a strength training device mounted on a telescoping frame. When the telescoping frame is expanded, a user can conveniently engage in elliptical exercises. When the telescoping frame is contracted, a user can conveniently engage in strength training exercises. The telescoping frame also provides convenient storage.

[0012] At least a portion of one exercise device, such as certain operable components of the elliptical device, can be mounted on one part of the frame, while at least a portion of the other device, such as certain operable components of the strength training device, can be mounted on another part of the frame. As such, the two portions can be telescopically contracted and expanded, relative to the other.

[0013] In addition, one or more sensors and motors can be positioned within the exercise system. The one or more sensors and motors can be configured to transfer (or perform an action on) respective electronic signals sent to and/or from a user. An electronic console can facilitate the signal transfers, and can receive (and send) electronic signals from the one or more sensors or motors. In one implementation, the electronic console can allow a user to view exercise progress in both anaerobic and aerobic workouts, and/or to adjust anaerobic and aerobic resistance mechanisms.

[0014] These and other benefits, features, and advantages of the present invention will become more fully apparent from the following description and appended claims, or may be learned by practicing the invention as set forth below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] A more extensive description of the present invention, including the above-recited features and advantages, will be rendered with reference to the specific embodiments that are illustrated in the appended drawings. Because these drawings depict only exemplary embodiments, the drawings should not be construed as imposing any limitation on the present invention's scope. As such, the present invention will be described and explained with additional specificity and detail through use of the accompanying drawings in which:

[0016] **FIG. 1A** is a side view of a telescoping exercise system having an aerobic, elliptical device and an anaerobic, strength training device in accordance with an implementation of the present invention;

[0017] **FIG. 1B** is a side view of the exercise system depicted in **FIG. 1A**, wherein the system is contracted;

[0018] **FIG. 2A** is a close up, side view of the operating components of the elliptical device of the exercise device of **FIGS. 1A-2A**;

[0019] **FIG. 2B** is a side perspective view of the elliptical device depicted in **FIG. 2A**;

[0020] **FIG. 3** is a close up, top perspective view of a telescoping portion of the frame of the exercise system depicted in **FIGS. 1A-2A**;

[0021] **FIG. 4** is a close up, front view of the telescoping frame shown in **FIG. 3**;

[0022] **FIG. 5A** is a plan view of a release handle and related components of the telescoping frame shown in **FIG. 3**;

[0023] **FIG. 5B** is a plan view of the release handle and related components depicted in **FIG. 5A**, wherein the release handle and related components are disengaged;

[0024] **FIGS. 6A and 6B** are side perspective views of an anaerobic resistance assembly and repetition sensor of the exercise system of **FIGS. 1A and 1B**;

[0025] **FIG. 7** is front view of an electronic console of the exercise system of **FIGS. 1A and 1B** for managing anaerobic and aerobic exercise information in accordance with an implementation of the present invention;

[0026] **FIG. 8** is a software block diagram for receiving, processing, and displaying information on an electronic console such as the console of **FIG. 7**;

[0027] **FIG. 9A** is a side view of an elliptical device mounted on another embodiment of a multi-part frame, wherein the elliptical device is expanded relative to the strength training device in a pivoting fashion; and

[0028] **FIG. 9B** is a side view of **FIG. 9A** wherein the elliptical device is compacted relative to the strength training device in a pivoting fashion.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] The present invention relates generally to systems, apparatuses, and methods that enable a user to perform anaerobic and/or aerobic activities on a compactable exercise machine. In particular, a user can move an exercise machine into a contracted position, an expanded position, or some combination therebetween, so that the user can access the exercise machine for primarily aerobic exercise, primarily anaerobic exercise, or some combination of both, as appropriate.

[0030] **FIGS. 1A and 1B** demonstrate respective extended and contracted views of an aerobic and anaerobic exercise system **100** comprising: (i) a multi-part, telescoping frame **102**; (ii) an aerobic, elliptical exercise device **104** coupled to frame **102**; and (iii) an anaerobic, strength training device **106** coupled to frame **102**. The strength training device **106** shown has a cable-based resistance system, although other systems may also be employed in place of device **106**.

[0031] A multi-part frame, such as telescoping frame **102**, allows exercise system **100** (also referred to sometimes as an exercise "machine") to be (i) extended, enabling convenient aerobic, elliptical exercise; or (ii) compacted, enabling convenient anaerobic, strength training exercise. By enabling convenient elliptical exercise and/or strength training exercise, system **100** is efficient and economic. Also, by being compactable, system **100** can be conveniently stored. Strength training device **106** is compact and lightweight. Frame **102** and devices **104**, **106** form a unique exercise apparatus to which a unique electronic console (or unique electronic console system) is coupled. These and other advantages will now be described in additional detail, beginning with a description of the telescoping frame **102** shown in **FIGS. 1A-1B**.

[0032] Telescoping frame **102** comprises a stationary portion **108*a*** and a telescoping portion **108*b***. Generally, a "telescoping portion" can be understood as a moving portion that moves inside or away from a "stationary portion". Of course, a manufacturer can also configure telescoping frame **106** such that portion **108*b*** is actually the stationary portion, and such that portion **108*a*** is actually the telescoping portion. As such, designations of "telescoping" or "stationary" with respect to the frame components are arbitrary, and may be switched by the manufacturer depending on the type of components used in the exercise system **100**.

[0033] In one implementation, stationary portion **108*a*** and telescoping portion **108*b*** can be configured such that telescoping portion **108*b*** cannot completely separate from the stationary portion **108*a*** after full expansion. The stationary portion **108*a*** and telescoping portion **108*b*** can also be configured such that the telescoping portion **108*b*** can be fully contracted with respect to the stationary portion **108*a*,** fully expanded from the stationary portion **108*a*,** or only partially expanded or contracted. As such, a manufacturer can implement a wide variety of options for configuring a contractible exercise system **100**.

[0034] Continuing with **FIG. 1A**, frame **102** further comprises one or more release handles **110** for contracting or expanding frame **102**, and one or more rollers **112*a-b*,** in order to help position the system **100**. Release handle **110** releasably secures frame **102** at different states of contraction or expansion. Rollers **112*a-b*** are positioned at an end of one or more of the stationary portion **108*a*** and the telescoping portion **108*b***. Rollers **112*a-b*** can help a user move the entire exercise system **100** and rollers **112*b*** can also help move the telescoping portion **108*b*** within and without the stationary portion **108*a*,** as needed.

[0035] Frame **102** further comprises (i) an upstanding member **114** that is coupled to stationary portion **108*a*;** and (ii) pulley attachment beams **116*a-b*** which extend from upstanding member **114** at different positions to provide the user with exercise access points to a resistance assembly **118** of the strength training device **106**. Additional details relating to the telescopic coupling of frame **110** will be discussed in detail below.

[0036] With continued reference to **FIGS. 1A-1B**, elliptical exercise device **104** will now be discussed in additional detail. Elliptical exercise device **104** comprises (i) a crank **120** movably coupled to telescoping portion **108*b*** of frame **102**; and (ii) first and second opposing foot supports **122*a-b*** movably coupled to crank **120**. In one implementation, the crank **120** is coupled to the telescoping portion **108*b*** through a bracket (not shown). For example, the bracket may comprise a securing portion at the lower end of the bracket for securing the bracket to the telescoping portion **108*b*.** The bracket may further comprise an extension that terminates in a perpendicular axle. The crank **120** may then be mounted on the bracket about the axle. In another implementation, the axle can extend from an inner wall of the elliptical device **104** housing.

[0037] In the illustrated implementation, the crank **120** further comprises means for providing the back ends of the opposing foot supports **11***a-b* with cyclical motion. To provide such a motion, the illustrated crank **120** comprises a flywheel **124** that rotates about an axis. The flywheel **124** comprises pivoting rods **126***a-b* that are mounted about the flywheel **124** periphery, and that extend in opposite directions relative to each other. In the illustrated implementation, one pivoting rod **126***a* is positioned approximately 180° about the flywheel **124** periphery relative to the other pivoting rod **126***b*. The opposing foot supports **122***a-b* are then pivotally joined to the flywheel **124** at the respective, pivoting rods **126***a-b*. When the flywheel **124** turns a given direction, the back end of the foot supports **122***a-b* move in a respectively cyclical motion about the flywheel **124** axis.

[0038] One will appreciate, however, that other implementations of a crank **120** can be used in accordance with the present invention. For example, the crank can comprise two opposing arms that rotate about an axis, such as bicycle-type crank arms (not shown), wherein the back end of the foot supports **122***a-b* pivotally connect to the extreme ends of the arms. In another implementation, the crank comprises two opposing flywheels rotating about the same axis, wherein one pivoting rod extends from one flywheel, and the opposing rod extends in an opposite direction from the opposing flywheel. In each case, the given crank simply provides the foot supports **122***a-b* with cyclical motion.

[0039] Continuing with the elliptical device **104**, the front ends of the respective foot supports **122***a-b* comprise respective wheels **123***a-b* that are configured to move in basically linear back and forth motions. In use, wheels **123***a-b* of respective foot supports **122***a-b* contact and move back and forth within grooves on the stationary portion **108***a* of frame **102**. This results in an overall elliptical motion for the elliptical device **104** when combined with the cyclical motion of the foot support **122***a-b* back ends.

[0040] Elliptical device **104** further comprises (i) a resistance wheel **128** movably coupled via a belt to flywheel **124**; and (ii) a resistance mechanism that adjustably applies resistance to the resistance wheel **128** (e.g., through magnetic resistance), which together serve to adjust resistance to the movement of flywheel **124**.

[0041] Thus, in the implementation shown in **FIG. 1A**, the operable components (e.g., foot supports **12***a-b* and crank **120**) of elliptical device **104** are coupled to the telescoping portion **108***b* of frame **102**, whereby such components of device **104** are easily positioned close to or away from strength training device **106**. Such operable components can be coupled alternatively to stationary portion **108***a* of frame **102**, while the anaerobic device **106** can be coupled to the telescoping portion **108***b*. In such an alternative embodiment, the anaerobic device **106** may be movably positioned with respect to the aerobic device **104**.

[0042] Also as shown in **FIGS. 1A and 1B**, elliptical device **104** further comprises first and second user stabilizing handles **140** (only one shown handle **140** shown) coupled to opposing sides of upstanding member **114** and extending rearward in order to be conveniently grasped by a user. Stabilizing handles **140**, can provide balance during certain exercises, and may also include sensors (not shown) that measure the user's pulse during still other exercises. Upstanding member **114** further provides a convenient post on which to mount some or all of the components of anaerobic device **106**.

[0043] Anaerobic device **106** comprises (i) a resistance assembly **118** coupled to the front portion of upstanding member **114**; and (ii) one or more exercise stations, such as pull handles **142***a-d* linked to resistance assembly **118** via a pulley and cable system that is coupled to and extends through frame **102**. Resistance assembly **118** provides adjustable resistance to movement of handles **142***a-d*. **FIGS. 1A and 1B** generally depict the components and use of resistance assembly **118** in solid and broken lines. As shown, resistance assembly **118** comprises a resistance assembly frame **143** that is coupled to upstanding member **114**. The additional components of resistance assembly **118** will be described in additional detail below.

[0044] Implementations of the exercise system **100** include one or more electronic consoles **144** that gathers, receives, processes, and displays data between one or more components (e.g., stabilizing handles **140**), as well as the aerobic, elliptical device **104** and anaerobic, strength training device **106**. For example, data received from sensors mounted on opposing right and left stabilizing handles **140** are output directly at a display interface on the electronic console **144**, thereby indicating the user's heart rate. Furthermore, data received from each of elliptical device **104** and strength training device **106** can be combined, processed, and displayed as appropriate back to the user.

[0045] With continued reference to FIGS. **1**A-B, system **100** can further comprise additional features which aid the user in either comfort or balance. For example, a pad **150** is attached to upright member **114**, and can be useful as a knee pad when a user is facing pad **150**, or as a backrest when a user is seated (as in **FIG. 1B**), or when the user is facing away from pad **150** and desires to rest against it, depending upon a given exercise. Furthermore, a pad **152** is mounted on a housing **121** surrounding the crank **120**, forming a padded bench on which a user can sit while performing exercises.

[0046] A leg exercise system, such as a leg extension assembly **153**, comprising a leg extension bar **154** is movably coupled to pad **152**, thereby enabling knee extension exercises. The leg extension assembly **153** further comprise leg contact members **155** (only one shown) on opposing sides of bar **154**. A cable may connect a hook **156** mounted on bar **154** to resistance assembly **118** (e.g., by connecting to handle **142***a* or a connector associated therewith). The cable may extend from hook **156** through hooks **158***a-b* to handle **142***a* (or an associated connector) in order to keep the cable away from the operable components of elliptical device **104**.

[0047] In one implementation, a user may desire to sit on the pad **152** and perform anaerobic, strength training exercises at one or more exercise stations when crank **120** is positioned close to strength training device **106** (e.g., as in **FIG. 1B**). This can enable the user to lean back against pad **150** when sitting to perform certain exercises, e.g., by pulling one or more handles **142***a-d,* or by performing leg extensions against using assembly **153**. Of course, specific positioning of crank **120** with respect to the anaerobic device **106** is not required for all aerobic or anaerobic activity on exercise system **100**.

[0048] **FIG. 1B** further shows that the exercise system **100** can comprise multiple electronic consoles in an electronic console system, such as electronic consoles **144***a* and **144***b* (phantom). For example, one electronic console **144***a* can be mounted directly to the frame **114**, while another electronic console **144***b* can be embedded inside pad **152** so that it is viewed when the user is seated. In one embodiment, one electronic console **144***a* is configured to display primarily aerobic data, while a second electronic console **144***b* is configured to display anaerobic data based on use of the strength training device **106**. In other embodiments, the exercise system **100** can further comprise an electronic console system having three or more electronic consoles for specific exercise devices, as appropriate.

[**0049**] Thus, for example, a workout or training program can be geared to display information through each of the one or more electronic consoles (e.g., one console—**144**, or multiple consoles—**144***a,* **144***b,* etc., as appropriate). In particular, the workout or training program can be configured to output elliptical workout instructions, and elliptical data at one display interface (e.g., console **144**, or **144***a,* as appropriate), and, at an appropriate time, output strength training workout instructions and related strength training workout data at the same or another display interface (e.g., console **144**, or **144***b,* as appropriate). For example, strength training and elliptical exercise data can be displayed at one or more corresponding display interfaces at one electronic console **144**. Alternatively, elliptical data can be displayed through one or more corresponding display interfaces at electronic console **144***a,* while strength training data is displayed only at the corresponding one of multiple electronic console **144***b*.

[**0050**] In this manner, one console **144** or multiple consoles **144***a,* **144***b* of the exercise system **100** (which are user linked), can be utilized to perform "circuit training" with anaerobic and aerobic exercises. In general, circuit training involves implementation of an exercise program to direct a user to perform certain exercises on one machine, and other exercises on another machine. This can be done through displays at one console, or through multiple displays (e.g., first and second displays) at respective multiple consoles. For example, an exercise program can be displayed to a user through a first console display at one exercise device, telling a user to perform 15 minutes of aerobic training; and then the program can direct the user to another, second, console display, where the second display tells the user to perform 25 repetitions of another exercise on a strength training device, and so forth. In one implementation, the circuit training identifies the user or exercise data as it is performed, can modify its instructions accordingly, and completes after the user has finished the instructions shown at each corresponding one or more displays.

[**0051**] **FIG. 2A** and the following discussion outline the elliptical device **104** in greater detail. For example, the illustrated elliptical device **104** comprises pivoting rods **126***a* and **126***b* that connect the respective backend of a foot support (e.g., **122***a* and **122***b*) to flywheel **124**. Belt **160** couples the flywheel **124** to the resistance-based, flywheel **128**. A belt tensioner **162**, positioned along the belt **160**, can help keep the belt tensioned so that it does not slip out of position.

[**0052**] The elliptical device **104** also comprises a "C"-shaped aerobic resistor **164** for adjusting the elliptical resistance, wherein the aerobic resistor **164** can be varied at least in part by a spring-based adjustment system **166**. For example, aerobic resistor **164** is configured such that contraction of the aerobic resistor **164** by the spring-based adjustment system slows the movement of the resistance flywheel **128**; while releasing the braking mechanism **164** frees the motion of the resistance flywheel **128**. In one implementation, the aerobic resistor **164** may comprise eddy magnet brakes, although a wide variety of brakes or other resistance apparatus can be used within the context of the invention. The spring adjuster **166** contracts or expands the aerobic resistor **164** relative to the resistance flywheel **128**. In one implementation, the spring adjuster **166** may be adjusted based on user input (e.g., through electronic signals sent from the console **144** to a motor coupled to the spring adjuster **166**).

[**0053**] The implementation of **FIG. 2B** further shows that the pivoting rod **120** comprises two solid disk flywheels **124** (i.e., **124***a* and **124***b*). In particular, the flywheels **124***a-b* are each connected about an axle, where one disk is connected to a foot support **122***a* through a pivoting rod **126***a,* while another disk is connected to the other foot support **122***b* through another pivoting rod **126***b.* Alternatively, the flywheel **124** may comprise one solid disk positioned about an axle, where the flywheel **124** also connects to the respective foot supports with respective pivoting rods **126***a* and **126***b.* Generally, a solid disk flywheel **124** can provide additional balance and stability to the elliptical exercise system **104**, in addition to some cost considerations. For example, it may be less expensive, in some implementations, to use a solid disk as the outer wall of an aerobic system **104** housing **121**.

[**0054**] **FIG. 3** and the following description provide detail concerning the telescoping frame **102** and associated components. For example, as shown in **FIG. 3**, one or more inner side rollers **168** roll along the side walls of the inner cavity in the stationary portion **108***a.* As well, one or more bottom rollers **170** roll along the lower surface of the inner cavity of the stationary portion **108***a.* At least one advantage to using side and bottom rollers in this manner is that rollers **168** and **160** can help metallic frame parts move together much more fluidly than, for example, using only grease to overcome frictional forces. Furthermore, the ease of movement provided by the described rollers can make the compacting and expanding ability of the exercise system **100** accessible to any user.

[**0055**] **FIG. 4** illustrates a front view of the telescoping portion **108***b* when the telescoping portion **108***b* is positioned within the stationary portion **108***a,* such that the exercise system **100** is compacted. In one implementation, one or more stoppers set toward the front of the stationary portion **108***a* may be used to set a maximum insertion point of the telescoping portion **108***b.* This can be done when one or more of the wheels **160** of the telescoping portion **108***b* abut the one or more respective stoppers of the stationary portion **108***a* when the exercise system **100** is fully compacted. In another implementation, one or more back stoppers (not shown) can be used to set a maximum expansion point of the telescoping portion **108***b* relative to the stationary portion.

[**0056**] At or between the maximum and minimum compaction points, releasable securing means, such as release handle **110**, can be used to secure the telescoping portion **108***b* in various positions. For example, **FIG. 5A** illustrates a release handle **110** in an engaged (or "secured") position with respect to the stationary portion **108***b*. As used herein, the term "engaged" can refer generally to a position of the release handle **110**, in which the telescoping portion **108***b* can be prohibited from compacting or expanding, relative to the stationary portion **108***a*. Conversely, the term "disengaged" or "released", with reference to the release handle **110**, can refer to the position of the release handle **110** in which the telescoping portion **108***b* can be free to contract or expand with respect to the stationary portion **108***a*.

[**0057**] As further illustrated in **FIG. 5A**, an implementation of the release handle **110** comprises (i) an outer sheath **184***a,* which resides primarily inside the stationary portion **108***a* of the telescoping frame **110**; (ii) a spring bias **174** within the outer sheath **184***a;* (iii) one or more inner sheaths **184***b* extending from the outer sheath **184***a;* and (iv) a detent **178** that is biased by the spring **174**. When a user moves the release handle **110**, the user compresses the spring bias **174** as the user moves the handle **110** in toward the telescoping portion **108***b*. In so doing, the user extends the handle detent **178** from the one or more inner sheaths **184***b* into a respective cavity **180** in the telescoping portion **108***b*. The user locks the release handle **110** into position by rotating the handle, such that a shaft detent **182** slips into securing slot **176***a*.

[**0058**] A user can, of course, also disengage the release handle **110** so that the telescoping portion **108***b* can be repositioned with respect to the stationary portion **108***a*. As shown in **FIG. 5B**, for example, the release handle **110** is rotated and released (e.g., pulled or pushed) away from the stationary portion **108***a,* such that the handle detent **178** pulls out of the groove or cavity **180**. In one particular implementation, when a user rotates the release handle, the springs **174** become uncompressed, and force the handle **110** into an extended position. Once the handle is extended, the user then locks the handle **110** in the disengaged position by positioning shaft detent **182** into slot **176***b*. The telescoping portion **108***b* can then move freely with respect to the telescoping portion **108***a*. One will appreciate that the stability of such a locking mechanism is particularly important for a user performing relevant exercises such as on the exercise system **100**.

[**0059**] **FIGS. 6A-6B** and the following description provide greater detail regarding the resistance assembly **118** of strength training portion **106** (see also **FIGS. 1A-1B**). In particular, **FIG. 6A** illustrates a schematic overview of one resistance assembly **118** having cables **186** that couple the resistance assembly **118** to one or more exercise stations. **FIG. 6B** provides a more particular illustration of the resistance assembly **118** shown in **FIG. 6A**, further showing the one or more operations for the respective resistance and repetition counting parts.

[**0060**] In general, resistance assembly **118** is configured such that, when a user exerts a force by pulling one or more pull handles **142***a-d,* leg extension assembly **153** or another suitable exercise station, a respective cable **186** pulls against a resistance provided by resistance assembly **118**. Resistance assembly **118** may be employed as a self-contained assembly that may be portable to a variety of different exercise systems. Similar and alternative representations and operations of the depicted resistance assembly **118** are described in U.S. Pat. No. 6,685,607, filed on Jan. 10, 2003, entitled "EXERCISE DEVICE WITH RESISTANCE MECHANISM HAVING A PIVOTING ARM AND A RESISTANCE MEMBER", the entire contents of which are incorporated herein by reference.

[**0061**] As shown, resistance assembly **118** comprises: (i) a frame **143** configured to be mounted to an exercise device frame, such as frame **102**; (ii) a cable **186** having opposing ends that are configured to be coupled to one or more exercise stations, e.g., handles **142***a-b;* (iii) a pair of resilient resistance bands **196**, each coupled at a lower end thereof to frame **143**; (iv) a "primary" pivoting plate assembly **202** movably coupled below bands **196** to frame **143**; and (v) a threaded drive member **200** movably coupled to the pivoting plate assembly **202**. The illustrated resistance assembly **118** still further comprises: (vi) a cross beam **198** movably coupled to the threaded drive member **200** at one end via threaded pivoting member **198***a,* and, at an upper end, the cross beam **198** is coupled to another end of the resilient resistance bands **196**. The respective bands **196** are therefore connected to cross beam **198** in such a way that the respective bands **196** are moveable within respective slots **192***a* in frame **143**.

[**0062**] The illustrated resistance assembly **118** yet still further comprises: (vii) a motor **204** configured to selectively turn threaded drive member **200**; (viii) a "secondary" pivoting plate assembly **206** movably coupled to primary pivoting plate assembly **202**; and (ix) a series of pulleys mounted to frame **143** and the secondary pivoting plate assembly **206**, for receiving or transferring cable **186** therein. In general, cable **186** extends through one or more cavities in frame **143**, as shown in FIGS. **6**A-B, around the corresponding pulleys, and ultimately back into respective exercise handle stations coupled to frame **143** (e.g., handles **142***a-b*). Secondary cables may be coupled to handles **142***c-d* and to respective coupling joints **145***a-b* of cable **186**.

[**0063**] Upon movement of an exercise station, such as handle **124***a,* pivoting plate assembly **202** moves against resistance provided by resilient resistance bands **196**, as depicted by the extended broken lines shown in FIGS. **6**A-B. The resistance applied by bands resistance can be adjusted by adjusting the position of cross beam **198** along threaded drive member **200**. Such adjustment can occur by actuating drive motor **204** to thereby turn threaded drive member **200** within threaded pivoting member **198***a* of cross beam **198**. Threaded drive member **200** can thus be turned to move cross beam **198**, and hence change the angle against which force is applied to the resilient bands **196**, hence changing resistance. In at least one implementation, drive motor **204** is configured to rotate the threaded drive member **200** based on one or more electrical signals that may be received from console **144**, for example.

[**0064**] In particular, when the respective cable **186** moves upward (+x), pivoting plate assembly **202** is pulled in an upward, arcuate manner (+y) toward the resistance assembly frame **143**. In addition, the cross beam **198** rotates about the threaded pivoting member **198***a* **116***a,* which is in a fixed position set at least in part by the motor **204**. This movement of the cross beam **198** causes the flexible resilient bands **196** to stretch in a respective direction (+x) along the slots **192***a*. As shown, stretching of the resilient resistance bands **196** along the assembly slots **192***a* and **192***b* (+/−x) may be facilitated at least in part by resistance wheels **194***a-b*.

[0065] When the user releases the force, such as by releasing the pulling handle (e.g., **142***a*), the respective cable **186** moves back toward the resistance frame **111** (−x). This causes the pivoting plate assembly **202** to move in the reverse arcuate direction (−y). This further causes the cross beam **198** and resilient resistance bands **196** to move or contract in reverse directions (−x), such that the cables **186** and resilient bands **196** are in a relatively relaxed state.

[0066] One can appreciate, therefore, that the position of the cross beam **198** relative to the resistance assembly frame **143** has an effect on the angle at which the resilient resistance bands **196** are stretched. In particular, a smaller angle θ between the cross beam **198** and resilient resistance bands **196** provides a greater leverage angle (i.e., easier) to stretch the bands **196**, while a greater angle θ provides a lesser leverage angle (i.e., more difficult) to stretch the bands in the resistance member **118**. Thus, the resistance of the resistance assembly **118** in **FIGS. 6A-6B** can be adjusted by adjusting the resistance angle θ, which can be implemented by threaded pivoting member **198***a* along the threaded drive member **200**.

[0067] In particular, the assembly motor **204** is electrically coupled to the electronic console **144** via respective circuit wires (not shown). The motor **204** can be configured in one implementation to adjust the resistance of the resistance assembly **118** based on user input. For example, when the user selects an anaerobic resistance value, such as by selecting a resistance value at an input interface at the electronic console **144**, a respective electronic signal sent to the motor **204** causes the motor **204** to rotate the threaded drive member **200** a certain amount. The cross beam **198** thus moves along the threaded drive member **200** into a new position, which further causes the pivoting plate assembly **202** to be positioned closer to (or further from) the resistance assembly frame **143**.

[0068] **FIGS. 6A and 6B** further illustrate a repetition sensor **210** that may be used in accordance with the exercise system **100**. In particular, one implementation of a repetition sensor **210** comprises a voltage generator **218** having a frame **220** that is mounted to the resistance assembly **118**, a spring bias **216**, and a coupling member **212** (such as a ribbon) that is attached to the pivoting plate assembly **202**. When the pivoting plate assembly **202** moves with a user's exercise motion, the coupling member **212** moves a corresponding direction, causing the voltage generator **218** to send an electrical signal to the electronic console **144** through respective electrical wires **210**.

[0069] A more particular description of using a voltage generator as a repetition sensor to detect anaerobic repetitions is found in commonly-assigned U.S. patent application Ser. No. ______/______ (Workman Nydegger Attorney Docket No. 13914.970) of Kowallis, et al., filed on Aug. 11, 2004 via U.S. Express Mail Number EV 432 689 389 US, entitled "REPETITION SENSOR IN EXERCISE EQUIPMENT", the entire contents of which are incorporated herein by reference. Other sensors may be employed to sense various parameters of the components of the exercise system **100**, such as resistance at the strength training device **106**.

[0070] The exercise system **100** can also be configured to provide a user with a digital readout of the resistance level chosen. As shown in FIGS. **1**A-B, and **6**A-B, for example, the electronic console **144** can be connected to an anaerobic meter **210**, such as a repetition sensor **210**, for monitoring anaerobic exercises. The electronic console **144** can also be connected to a conventional aerobic meter (not shown) for monitoring aerobic exercise data. The electronic signals received from the anaerobic and aerobic meters (as well as, for example, the stabilizing handles **140**) then combines, processes, and/or displays data to the user at the electronic console **144**, as appropriate.

[0071] Furthermore, an implementation of the electronic console **144** comprises an input interface so that a user can control anaerobic or aerobic resistance, rates of exercise, and so forth. For example, a user can select a level of anaerobic resistance at an input interface at the electronic console **144**. The electronic console **144** can then interpret the user input, and send a respective electronic signal to the drive motor **204** of the resistance assembly **118**. After receiving the electronic signal, the motor **204** can then rotate the threaded drive member **200** until the resistance assembly **118** is set to the desired resistance. One will appreciate that similar mechanisms is used to control the resistance and exercise rate of the aerobic exercise system **140**. Accordingly, a wide variety of electronic console mechanisms and displays is employed within the context of the present invention.

[0072] **FIG. 7** illustrates an implementation of one electronic console **144** that can be used in an electronic console system in accordance with the present invention. In particular, the depicted electronic console **144** can be configured to have input and output displays for both a strength training device **106** and an elliptical device **104**. For example, with respect to aerobic exercise data, such an electronic console **144** comprises a counter interface **230** that displays incremental factual data such as calories burned, heart rate, speed of exercise time of exercise, and distance traveled. In one implementation, the user's heart rate is measured from sensors at handles **142***a-d,* etc. and/or sensors at stabilizing members **140**. A selectable "Display" button **230***a* provides a user with the ability to change which data (e.g., which value of time, speed, distance, etc.) are displayed to the user at a given point in time.

[0073] Although such incremental data is typically applicable for aerobic data, display interface **230** can be implemented with aerobic and anaerobic data, as appropriate. The depicted electronic console **144** further comprises one or more interfaces for providing interactive views and data options. For example, the electronic console **144** comprises a display interface **232** that may be used for indicating the type of program or workout routine in which the user is engaged. A selectable "Next" button **232***a* allows a user to scroll, for example, from one program option to the next.

[0074] In addition, the depicted electronic console **144** comprises a resistance interface **234** that allows a user to increase or decrease resistance of the strength training device **104** and the elliptical device **104**. For example, the illustrated electronic console **144** can also comprise a selectable decrement button **234***a* (e.g., "−") and a selectable increment button **234***b* (e.g., "+") for making the respective resistance adjustments. In one implementation, for example, input from the user at buttons **234***a* and **234***b* causes the electronic console **144** to send a respective data signal to the elliptical device **104**, thereby causing the aerobic resistor **164** to change positions (hence resistance).

[0075] The depicted electronic console **144** still further comprises additional display interfaces that may be particularly useful for anaerobic exercise data. For example, the electronic console **144** comprises a display interface **236** for setting, displaying, or modifying the number of exercise repetitions, and a similar display interface **238** for setting, displaying, or modifying the number of exercise repetition sets. In particular, selectable "–" button **236***a* and selectable "+" button **236***b* may be configured so that a user can set a target number of reps in a routine. Furthermore, selectable "=" button **238***a,* and selectable "+" button **238***b* may also be configured so that a user can set a target number of sets in a routine.

[**0076**] An exemplary electronic console **144**, therefore, can take input from the user via one or more selectable buttons (e.g., **230***a,* **232***a,* **234***a,* **234***b,* etc.), and send a respective data signal to the respective aerobic or anaerobic exercise system, as appropriate. Similarly, the electronic console **144** can take an input from the electronic console **144** and send a respective data signal to circuitry in the resistance assembly **118**, thereby causing the motor **204** to modify the position of the cross beam **198** relative to the resilient resistance bands **196**, hence change resistance. Of course, the electronic console **144** can also receive electronic signals from the elliptical exercise device **104**, the resistance assembly **118**, and the gripping handles **142***a-d,* and provide the user with relevant information through the relevant display interfaces **230**, **232**, **234**, **236**, and **238**.

[**0077**] One will appreciate that the foregoing description for an electronic console in an electronic console system can also be readily modified for multiple electronic consoles in an electronic console system. For example, an elliptical electronic console **144***a* (see **FIG. 1B**) can comprise display interfaces **230**, **230***a,* and **232**, while a strength training electronic console **144***b* (see **FIG. 1B**) can comprise display interfaces **232**, **232***a,* **234**, **234***a-b,* **236**, **236***a-b,* **238**, and **238***a-b*. In short, there are a variety of ways in which one or more electronic consoles can be configured to display data to a user at one or more positions on an exercise system **100**. Furthermore, there are a variety of ways in which each such electronic console can be configured to receive specific types of input from a user, or from a given exercise device (e.g., elliptical device **104**, strength training device **106**).

[**0078**] **FIG. 8** illustrates one embodiment of the present invention, in block diagram form, representing software modules and system components that are suitable for implementing an electronic console **144** that displays elliptical data and strength training data in an electronic console system. For example, an embodiment of an electronic console **144** comprises a connection to a power source **240**, and further includes a Device I/O (Input/Output) module **246** for receiving and transferring electronic signals. In particular, Device I/O module **246** comprises circuitry for two-way strength training communication **242** to the strength training exercise device **106**, and comprises circuitry for two-way elliptical communication **244** to the elliptical exercise device **104**. The electronic console **144** further comprises an interface for receiving data from sensors at, for example, the stabilizing members **140**, etc.

[**0079**] In addition, the exemplary electronic console **144** comprises a processing module **250** that includes, for example, a central processing unit **252** and any other necessary active and/or passive circuitry components to operate the exercise system **100**. For example, the processing module can comprise volatile or non-volatile memory, any magnetic or optical storage media, any capacitors and resistors, any circuit traces for transferring data between components, any status indicators such as light emitting diodes, and any other processing components and so forth as may be appropriate.

[**0080**] The electronic console **144** itself may also comprise additional input and output components such as an Ethernet connection port, a telephone connection port, audio in and out ports, optical in and out ports, wireless reception and transmission ports, and so forth. One will appreciate, therefore, that, for the purposes of convenience, not all components and circuit traces that may be used are shown in **FIG. 8**.

[**0081**] As shown, the exemplary electronic console **144** comprises a connection to a Display I/O module **260**. In particular, Display I/O module **260** comprises user-interactive display components such as a two-way strength training I/O component **262** for receiving and displaying strength training data (i.e., "anaerobic" data **254**) to and from a user. The Display I/O module **260** comprises a two-way combination I/O component **264** for receiving and displaying combination data **258** to and/or from the user, and a two-way elliptical I/O component **264** for displaying to the user (and/or receiving from the user) elliptical data (i.e., "aerobic data") **256**. In one implementation, combination I/O data includes data that is not uniquely strength training or elliptical-based information. For example, combination I/O data may include selection of a generalized workout routine at interface **232**, wherein the workout routine includes instructions to the electronic console **144** for both elliptical and strength training resistance levels.

[**0082**] In operation, the processing module **200** can receive anaerobic, or strength training, data **254**, aerobic, or elliptical, data **256**, and combination data **258** from any of the respective strength training device **106**, elliptical device **104**, and the user. For example, the strength training device **106** may send one or more electronic signals to the electronic console **144**. In one implementation, these signals indicate to the electronic console **144** the amount of strength training resistance, or identify the number of strength training exercise repetitions performed, and so forth.

[**0083**] In addition, sensors in, for example, the stabilizing handles **140**, can send data signals to the electronic console **144** that can indicate the user's pulse rate count. Similarly, the elliptical system **104** may send one or more respective electronic signals to the electronic console **144,** such that the electronic console **144** can identify the amount of elliptical resistance, the number of revolutions of the flywheel **124**, the speed of the flywheel **124**, and so forth.

[**0084**] In addition to data received from the exercise portions **104**, **106**, and any other sensors, etc., the processing module **250** can also receive user input through the console's **144** interactive displays. This user-provided input can include selections for change in resistance, a change in speed, a change in incline, a change in exercise programs, and so forth. The processing module **250** can also receive user data such as the user's weight, age, height, and any other relevant data that may be useful for providing the user with accurate feedback, or for modulating the duration and intensity of a given workout.

[**0085**] When the processing module **250** receives appropriate data, a CPU **252** at the processing module **250** can then execute instructions. For example, the CPU can combine various data such as age, heart rate, exercise speed, weight, resistance, and other such parameters to provide the user with an accurate depiction of the calories burned, distance traveled, and so forth. In some cases, the CPU **252** may simply report the received data directly to a user display, and thus formats received data signals so that they can be read at a respective display. In other cases, the CPU **252** may simply calculate the data using one or more equations, as appropriate, before providing the user with a display value. In still other cases, the CPU **252** may simply format data received from a user (or surmised from a workout), and send the formatted data as a respective electronic signal to a motor at an exercise portion (e.g., **104**, **106**), and so forth.

[**0086**] One will appreciate, of course, that an electronic console system configured to implement multiple electronic consoles (e.g., **144***a*, **144***b*, etc.) may vary the implementation of the foregoing software modules and connection interfaces, as appropriate. For example, an electronic console **144***a* configured to display elliptical data may comprise elliptical communication circuitry **244**, aerobic I/O component **266**, and corresponding processing modules. By contrast, an electronic console **144***b* configured to display strength training data may comprise strength training circuitry **242**, as well as the anaerobic I/O component **262**, and corresponding processing modules.

[**0087**] Accordingly, the various implementations of the present invention enable a user to readily perform a wide range of elliptical and strength training exercises that are an important part of a workout routine. In particular, the various implementations of the present invention enable a user to perform a wide variety of strength training and elliptical exercises in a relatively small space since the exercise system is compacted or expanded by virtually any user. In addition, electronic data options provide a user with the ability to monitor and/or manipulate data for a wide range of strength training and elliptical exercises.

[**0088**] In addition, one of ordinary skill will appreciate that any number of strength training resistance systems such as those related to weight stacks, coil springs, shocks, elastomeric bands, resistance rods or bows or the like may be substituted for the present cable and pulley resistance system **106** within the context of the invention. Furthermore, any number of elliptical exercise systems such as steppers, gliders, skiers, striders, treadmills, exercise bikes, and so forth, can also be implemented in place of the depicted elliptical exercise system **104** within the context of the invention. Thus, an exercise system **100** of the present invention comprises (i) a first exercise device, e.g., elliptical device **104** coupled to frame **102** and (ii) a second exercise device e.g., strength training system **106** coupled to the frame. Frame **102** is configured such that at least a portion of the first exercise device can be compacted and expanded with respect to at least a portion of the second exercise device.

[**0089**] Another advantage of system **100** is that strength training exercise device **106** is operable independently from elliptical exercise device **104**. Thus, one user may use elliptical device **104** while a different user uses strength training device **106**. Another advantage of system **100** is that it features an elliptical exercise device, i.e., elliptical device **104**, linked to an anaerobic exercise device **106** through frame **102**, wherein at least a portion of the elliptical exercise device is movably coupled to at least a portion of the strength training device, such that the exercise system is capable of being moved from a compact position to an extended position. For example, it may be more convenient for a first user to use the strength training device **106**, and for a second user to use the elliptical exercise device **104**, while system **100** is in an extended position.

[**0090**] The present invention has been described with continued reference to a telescoping frame **102**. The telescoping frame, however, is simply one example of a multi-part frame which acts as an implementation for coupling two exercise devices in this manner. As shown in **FIGS. 9A and 9B**, for example, telescoping frame **102** is replaced by a pivoting frame, which is another example of a multi-part frame. In particular, one portion of an exercise device, such as the crank of an elliptical exercise device, may be coupled to a primarily stationary portion **108***c* of the pivoting frame, while a second exercise device may be coupled to a mobile portion **108***d* that swings about a pivot point **108***e*.

[**0091**] In particular, **FIG. 9A** shows that a portion of the elliptical device **104** can be tilted away from the strength training device **106** for performing elliptical exercises. By contrast, **FIG. 9B** shows that the portion of the elliptical device **104** can be tilted toward the strength training device **106**, such as when performing strength training exercises. As such, one will appreciate that there are a number of ways for providing a multi-part frame having multiple exercise devices thereon.

[**0092**] Exercise system **100** disclosed herein may optionally be referred to as comprising: (i) an elliptical exercise assembly, comprising: (A) a frame **102**; (B) a crank **120** movably coupled to frame **102**; and (C) first and second foot supports **122***a-b* movably coupled to the crank **120**; and (ii) a second exercise device (e.g., strength training device **106**) coupled to the elliptical exercise assembly. At least a portion of the elliptical exercise assembly can be movably positioned closer to and further away from at least a portion of the second exercise device.

[**0093**] It should therefore be appreciated that the present invention may be embodied in other forms without departing from its spirit or essential characteristics. As properly understood, the preceding description of specific embodiments is illustrative only and in no way restrictive. The scope of the invention is, therefore, indicated by the appended claims as follows.

We claim:

1. An exercise system comprising:

a frame;

a first exercise device coupled to the frame, the first exercise device comprising an elliptical exercise device; and

a second exercise device coupled to the frame.

2. An exercise system as recited in claim 1, wherein the second exercise device comprises an anaerobic exercise device.

3. An exercise system as recited in claim 2, wherein the second exercise system comprises a strength training exercise device that is operable independently from the elliptical exercise device.

4. An exercise system as recited in claim 3, wherein the second exercise device comprises a cable and pulley system coupled to a resistance mechanism.

5. An exercise system as recited in claim 4, wherein the resistance mechanism comprises at least one resilient band.

6. An exercise system as recited in claim 1, wherein the frame is a multi-part frame.

7. An exercise system as recited in claim 6, wherein the frame is a telescoping frame.

8. An exercise system as recited in claim 6, wherein the frame comprises a stationary portion and a telescoping portion.

9. An exercise system as recited in claim 1, wherein the frame is configured such that at least a portion of the first exercise device is compactible or expandable with respect to at least a portion of the second exercise device.

10. An exercise system as recited in claim 1, wherein the frame comprises a padded bench on which a user can sit while performing exercises.

11. An exercise system as recited in claim 1, wherein the frame comprises a padded bench against which a user can lean while performing exercises.

12. An exercise system comprising:

(i) a first exercise device comprising an elliptical exercise assembly, the elliptical exercise assembly comprising:

(A) a frame;

(B) a crank movably coupled to the frame;

(C) first and second foot supports movably coupled to the crank; and

(ii) a second exercise device coupled to the elliptical exercise assembly.

13. An exercise system as recited in claim 12, wherein the second exercise device is coupled to the frame of the elliptical exercise assembly.

14. An exercise system as recited in claim 12, wherein the second exercise device is operable independently from the elliptical exercise assembly.

15. An exercise system as recited in claim 12, wherein the second exercise device is a strength training exercise device.

16. An exercise system as recited in claim 12, wherein at least a portion of the elliptical exercise assembly is configured to be movably positioned closer to and further away from at least a portion of the second exercise device.

17. An elliptical exercise device having a compacted position and an extended position, comprising:

a multi-part frame, wherein a movable portion of the frame is movable with respect to a stationary portion of the frame; and

a elliptical exercise device comprising a crank, wherein the crank is coupled to the movable portion of the frame.

18. An elliptical exercise device as recited in claim 17, wherein the frame is a telescoping frame, comprising a telescoping portion and the stationary portion.

19. An elliptical exercise device as recited in claim 17, wherein the frame is a pivoting frame, comprising a pivoting portion and the stationary portion.

20. An elliptical exercise device as recited in claim 17, wherein the elliptical exercise device comprises a crank movably coupled to the movable portion of the frame, and first and second foot supports movably coupled to the crank.

21. An elliptical exercise device as recited in claim 17, further comprising a strength training exercise device coupled to the frame.

22. An elliptical exercise device as recited in claim 17, wherein the elliptical exercise device comprises at least one flywheel for facilitating elliptical motion, and a resistance device coupled to the at least one flywheel.

23. An elliptical exercise device as recited in claim 22, further comprising first and second foot supports coupled to the at least one flywheel, wherein the first and second foot supports engage the flywheel to produce elliptical motion.

24. An elliptical exercise device as recited in claim 17, wherein the frame comprises a padded bench on which a user can sit while performing exercises.

25. An exercise system configured to enable anaerobic exercise motion by a user and aerobic exercise motion by a user, the exercise system having a compact position and an extended position, the exercise system comprising:

an aerobic exercise device; and

an anaerobic exercise device linked to the aerobic exercise device, wherein at least a portion of the aerobic exercise device is movably coupled to at least a portion of the anaerobic device, such that the exercise system is capable of being moved from a compact position to an extended position.

26. An exercise device as recited in claim 25, wherein the aerobic exercise device comprises a padded bench mounted thereon, on which a user can sit while performing exercises with the anaerobic exercise device.

27. An exercise system as recited in claim 25, wherein the exercise system is configured such that the aerobic exercise device is configured to be used when the exercise system is in an extended position, and the anaerobic exercise device is configured to be used when the exercise system is in a compact position.

28. An exercise system as recited in claim 28, wherein the exercise system is configured such that the anaerobic exercise device operates independently from the aerobic exercise device.

29. An exercise system as recited in claim 28, wherein at least a portion of the aerobic device is mounted on one portion of a movable frame and wherein at least a portion of the anaerobic exercise device is mounted on another portion of the movable frame.

30. An exercise system as recited in claim 29, wherein the movable frame comprises a telescoping frame and wherein a crank of the aerobic device is coupled to one portion of the telescoping frame, and a resistance system of the anaerobic device is coupled to another portion of the telescoping frame.

31. An exercise system comprising:

a telescoping frame;

a first exercise device coupled to one portion of the telescoping frame, the first exercise device comprising an elliptical exercise device comprising (A) a crank movably coupled to the frame; and (B) first and second foot supports movably coupled to the crank; and a second exercise device coupled to another portion of the telescoping frame, the second exercise device comprising a strength training device, the strength training device comprising (A) a resistance assembly coupled to the frame; and (B) an exercise station linked to the resistance assembly, wherein the first exercise device is operable independently from the second exercise device, such that the telescoping frame is selectively movable from a compacted position to an extended position, and such that a user can selectively perform aerobic or anaerobic exercises on the exercise system.

32. An electronic console having one or more circuitry components for use in combination with anaerobic and aerobic exercise devices, the electronic console comprising:

one or more processing modules configured to process electronic data signals received from an anaerobic exercise device and an aerobic exercise device;

one or more first display interfaces for displaying anaerobic exercise data relayed from the one or more processing modules; and

one or more second display interfaces for displaying aerobic exercise data relayed from the one or more processing modules.

33. The electronic console as recited in claim 32, further comprising an input interface for adjusting one or more of an adjustable anaerobic resistance member and an adjustable aerobic resistance member.

34. The electronic console as recited in claim 32, wherein the aerobic exercise data comprise one or more of: (i) time spent exercising, (ii) calories burned, (iii) heart rate during exercise, (iv) exercise speed, and (v) exercise distance.

35. The electronic console as recited in claim 32, wherein the anaerobic data comprise at least one of: (i) a number of repetitions desired, (ii) a number of repetitions performed, (iii) a number of sets desired, and (iv) a number of sets performed.

36. The electronic console as recited in claim 32, wherein the anaerobic exercise device and the aerobic exercise device are on the same exercise system.

37. An exercise machine having at least one electronic console system, the exercise machine configured to enable anaerobic and aerobic exercises, comprising:

a frame having a first exercise device and a second exercise device coupled thereto;

a first electronic display interface configured to display electronic signals from the first exercise device; and

a second electronic display interface configured to display electronic signals from the second exercise device.

38. An exercise system as recited in claim 37, wherein the frame is a multi-part frame having a stationary portion, and a telescoping portion or a pivoting portion.

39. An exercise system as recited in claim 37, wherein the first and second electronic display interfaces are both linked to at least one of the first and second exercise devices of the exercise system.

40. An exercise system as recited in claim 37, wherein the first electronic display interface is configured to display aerobic exercise instructions to a user; and wherein the second electronic display interface is configured to display anaerobic exercise instructions to the user.

41. An exercise system as recited in claim 37, wherein the first electronic display interface and the second electronic display interface display exercise data on a single electronic console.

42. An exercise system as recited in claim 37, wherein the first electronic display interface and the second electronic display interface display exercise data a plurality of electronic consoles.

43. An exercise system as recited in claim 37, wherein the first electronic display interface and the second electronic display interface provide a user with workout instructions to perform circuit training on the exercise machine.

44. An exercise system as recited in claim 43, wherein the workout instructions to the user comprise at least one of (i) an anaerobic activity at the first exercise device; and (ii) an aerobic activity at the second exercise device.

45. An exercise system as recited in claim 44, wherein the first exercise device is coupled to a movable portion of the frame; and wherein the second exercise device is coupled to a stationary portion of the frame.

46. An exercise machine configured to enable a user to engage in aerobic and anaerobic exercises, comprising:

an exercise apparatus configured to enable a user to engage in aerobic and anaerobic exercises; and

an electronic console system coupled to the exercise apparatus, the electronic console system comprising:

one or more processing modules configured to process electronic data signals;

one or more first display interfaces for displaying anaerobic exercise data relayed from the one or more processing modules; and

one or more second display interfaces for displaying aerobic exercise data relayed from the one or more processing modules.

47. The exercise machine as recited in claim 46, wherein the exercise apparatus comprises a movable member.

48. The exercise machine as recited in claim 46, wherein the exercise apparatus comprises an anaerobic exercise device and an aerobic exercise device.

49. The exercise machine as recited in claim 46, wherein the exercise apparatus comprises a multi-part frame having a stationary portion, and a telescoping portion or a pivoting portion.

* * * * *


PRECOR

Precor C760-Series Climbers

Innovation Ensures Durability and Performance

Commercial fitness equipment buyers now have another choice in climbers. Precor, Incorporated, a leading manufacturer of cardiovascular fitness equipment, recently introduced the C760-series climbers: the C764 and C762. The new climbers have unique features that offer true innovation and value.

Examples of breakthrough technology include a drive system that needs no routine maintenance, because it employs durable, quiet belts instead of noisy chains or weaker cables, and a stairarm-and-footplate configuration that guarantees a strong, steady climbing motion instead of a system that rapidly deteriorates into loose instability. In addition, an advanced fall-rate control system delivers accurate speed adjustments and smooth, fluid climbing action—regardless of the weight or climbing style of the user.

"We set out to design a climber that provides real durability and performance," said Precor president Bill Potts. "Our engineers developed what is without a doubt the most meticulous life-testing processes in the industry. The reliability and user-friendliness of the C760-series isn't just a claim—it's been proven, from the first prototype up until we reached our goal."

Many design innovations distinguish the C760-series climbers, all of which influence the way the climber looks, feels, and performs, for exercisers and fitness facility owners alike.

The climber's strong steel frame and low center of gravity make it extremely stable. This helps exercisers feel steady and secure, even during vigorous workouts. Large footplates provide ample room for varied foot positions, which helps users avoid foot fatigue and allows them to work different leg muscles. It also means that feet won't hang over the front edges, increasing the sense of stability and confidence that's especially important for people who are new to exercise.

Precor uses a "mid-line positioning" of the footplates on the stair arms, which places the user's weight directly over the climber's load-carrying structures. This balances the load, reduces torque, and distributes forces equally within the system. Therefore, unlike other climbers, the C760-series system won't develop looseness or "slop," but will continue to provide a stable, controlled feel, even after extensive heavy use.

Other manufacturers attach their climbers' stair arms on the inside, as opposed to the middle, of each footplate. When a user stands on the climber, the torque pushes down on the outer, unsupported edge of the footplates. As the user moves the footplates and stair arms up and down, the torque results in uneven pressure on the climber's bushings— an application they are not designed for. Over time, the footplates will actually sag down and start to feel loose, sloppy, and uneven. For users, this can be annoying (since it can decrease the comfort and effectiveness of the workout) or even dangerous (since an unstable footplate can lead to twisted ankles and knees).

C760-series climbers provide smooth, consistent climbing motion regardless of variations in user weights and climbing styles. The electro-magnetic resistance system is frictionless, so it's extremely durable and requires no maintenance. Fall-rate control (the rate and consistency at which the footplates move downward) is extremely important; if fall rate isn't controlled accurately, the climber won't feel right.

Precor uses an infrared light interruption system to monitor the speed of the eddy-current disk— it can obtain up to 100,000 pulses per minute, or 1666 per second. Such precise readings result in exceptional accuracy. A sophisticated microprocessor controls current to the electro-magnet, prompting it to adjust resistance to maintain the user's desired speed.

Precor's belt drive system makes chains and cables obsolete. Chains are noisy and require frequent lubrication, deteriorate rapidly, and must be replaced frequently during average club use. Chains also stretch and make a lot of noise when they hit their sprocket— much like a worn-out bike chain. The lubrication process is messy, and lubricant can drip on the floor and climber, collecting dirt and dust.

Cables aren't a great option, either. As proved by cycle testing, Precor's belts last at least 10 to 12 times longer than a cable. When you bend a cable over a pulley, especially a smaller-size pulley, the outside fibers of the cable stretch (under tension) while the inside fibers are pushed together (under compression). Over time, repeated flexing will cause the cable to break, just as a wire coat hanger will break when it's repeatedly bent and straightened.

"C760-series climbers are extremely easy to use. The logical electronic console and workout programs don't intimidate beginners, yet capture the attention of experienced exercisers."

You can make a cable stronger by making it thicker— but when it's run over the same pulley, tension/compression forces are even greater. So, instead of making the cable thicker, you can add a second cable next to the first. To make it even stronger, add a third cable . . . and then a fourth. Soon you've made— a belt.

Workout Programs

C760-series climbers are extremely easy to use. The logical electronic console and workout programs don't intimidate beginners, yet they capture the attention of experienced exercisers. No complicated programming is required; exercisers simply press a few keys and start working out. Even more user-friendly— the "Quick Start" feature begins a basic manual program with one key. All displays are clear and uncomplicated. Exercisers can even choose how much (or how little) information they want to see.

With the C764 climber, exercisers can choose from among a manual course, a random course, an interval course, 2 custom courses, and 10 pre-programmed courses. All courses can be performed at 10 different work levels. Club owners can pre-set time limits for exercise sessions, from 10 to 240 minutes. The C762 which has no programmed courses, and allows exercisers to control climbing rate.

Console readouts include work level, time, floors climbed, floors per minute, segment time left, watts, mets, calories, calories per minute, horizontal distance, steps per minute, feet per minute, and meters per minute.

For more information on Precor's series of C760 Climbers, or any of Precor's products call (206) 486-9292, or write to P.O. Box 3004, Bothell, WA 98041-3004.

APPENDIX DD

US006705976B1

(12) **United States Patent**
Piane, Jr.

(10) **Patent No.: US 6,705,976 B1**
(45) **Date of Patent: Mar. 16, 2004**

(54) **EXERCISE APPARATUS**

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(52) **U.S. Cl.** **482/103**; 482/102; 482/138

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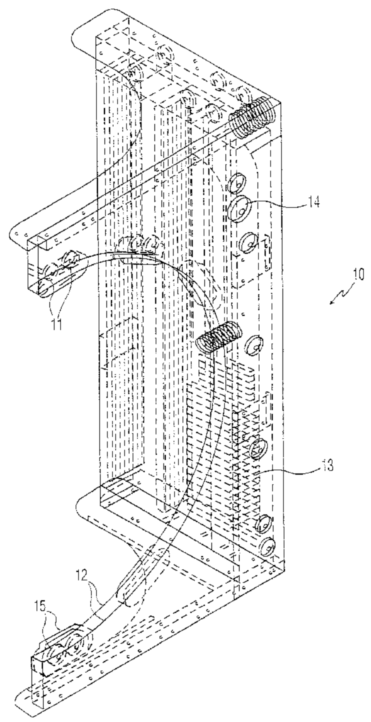
(57) **ABSTRACT**

Exercise equipment including a housing having a structural surface defining an arcuate path, multiple pairs of pulleys positioned along the arcuate path, each pair of pulleys having passed between them a cable the proximal end of which is located outside the curved path, the distal end of the cable being coupled to a source of resistance within the housing such that when the proximal end of the cable is pulled by a user, the resistance exerts a counterforce to the cable. Alternatively, a single cable may be provided which exits through a movable trolley which is fixable at different positions along the arcuate path.

71 Claims, 31 Drawing Sheets



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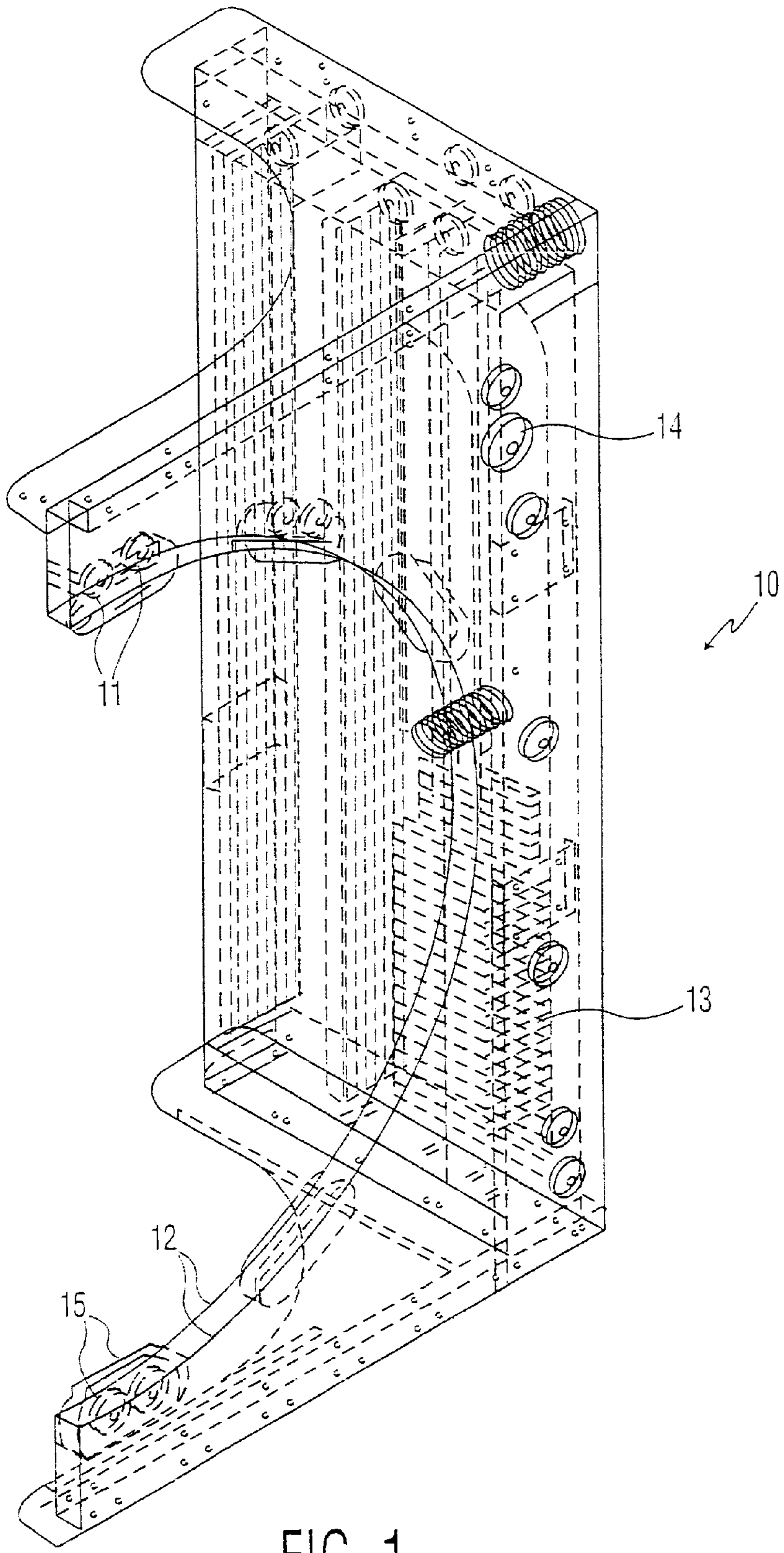

FIG. 1

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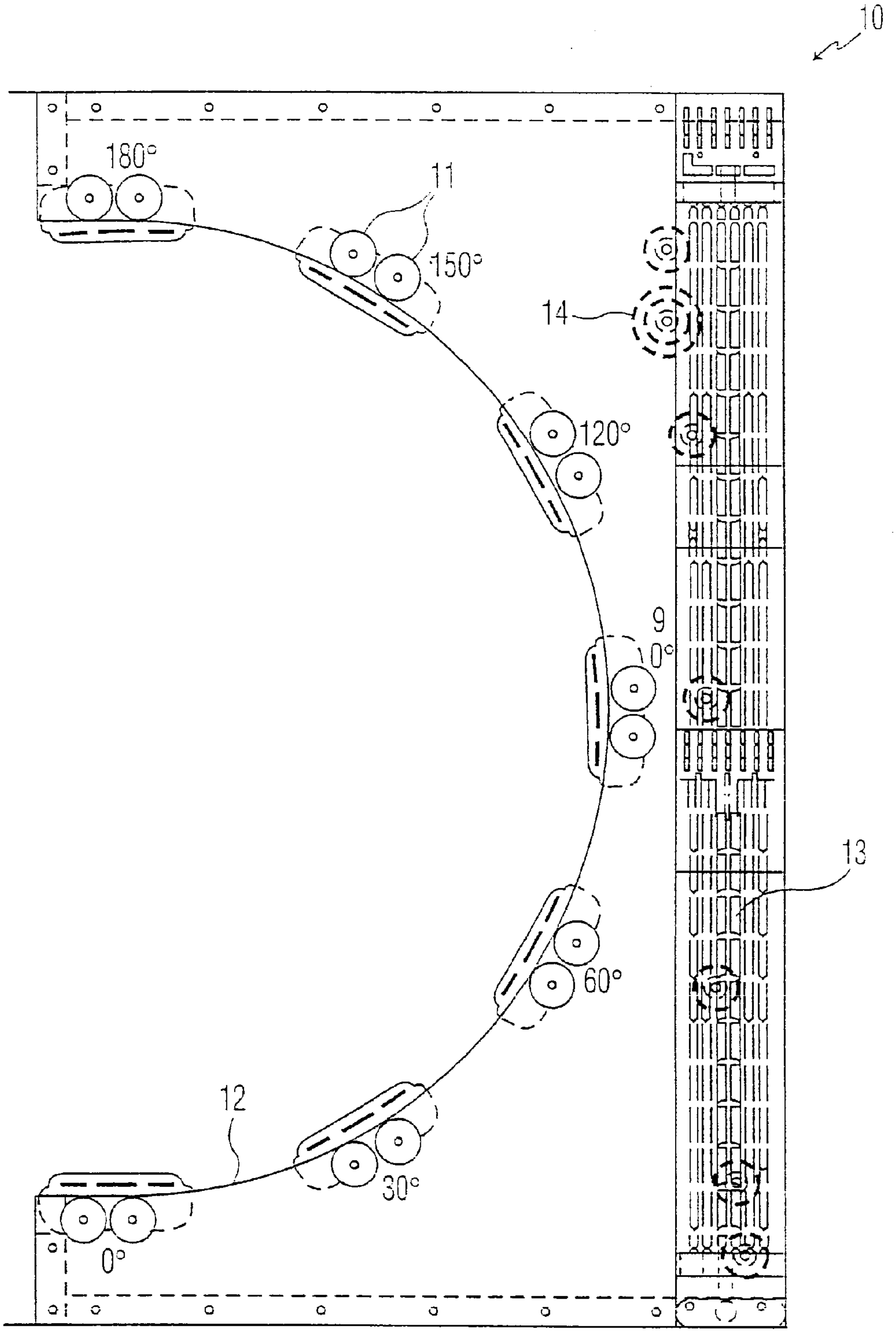

FIG. 2

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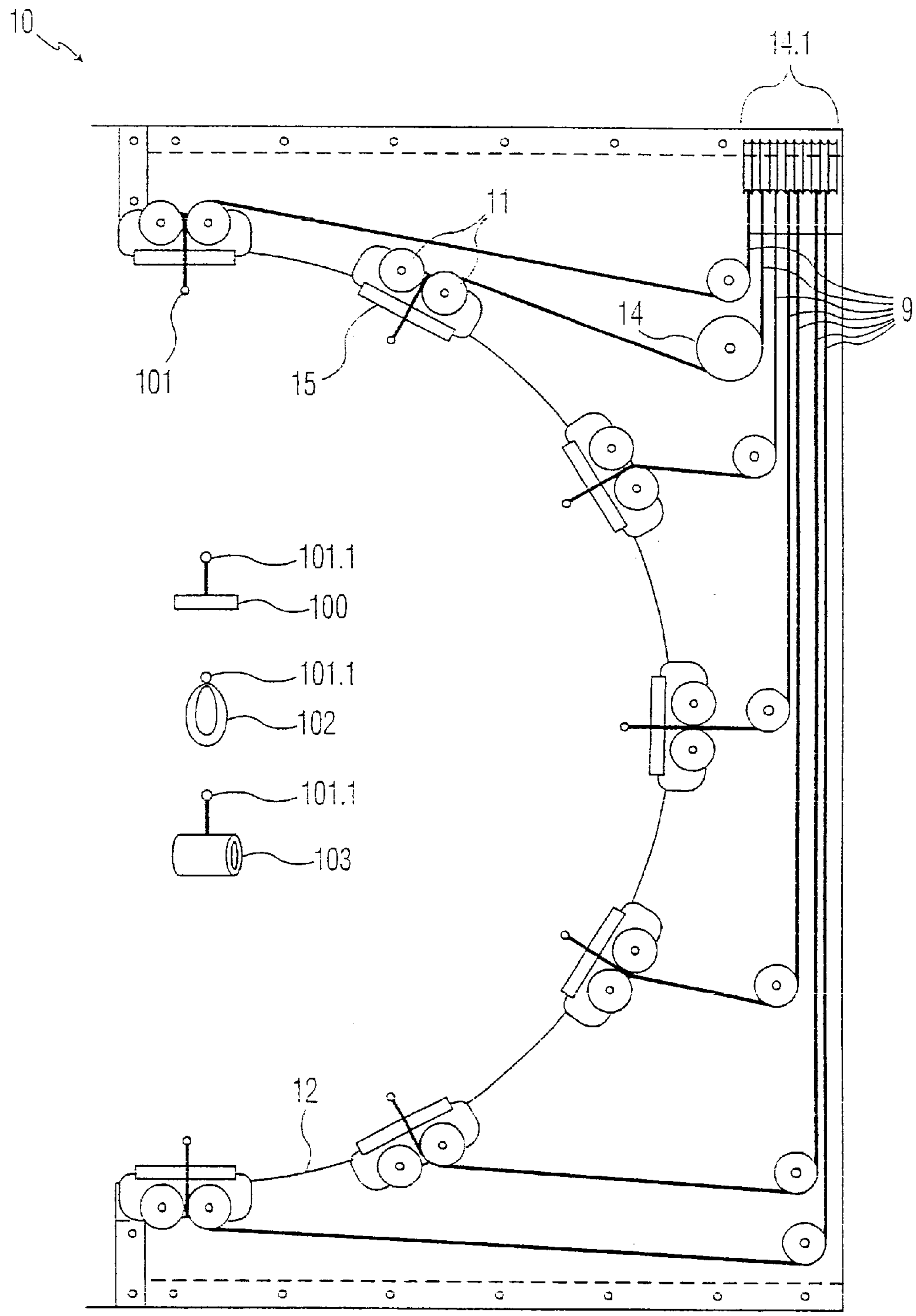

FIG. 3

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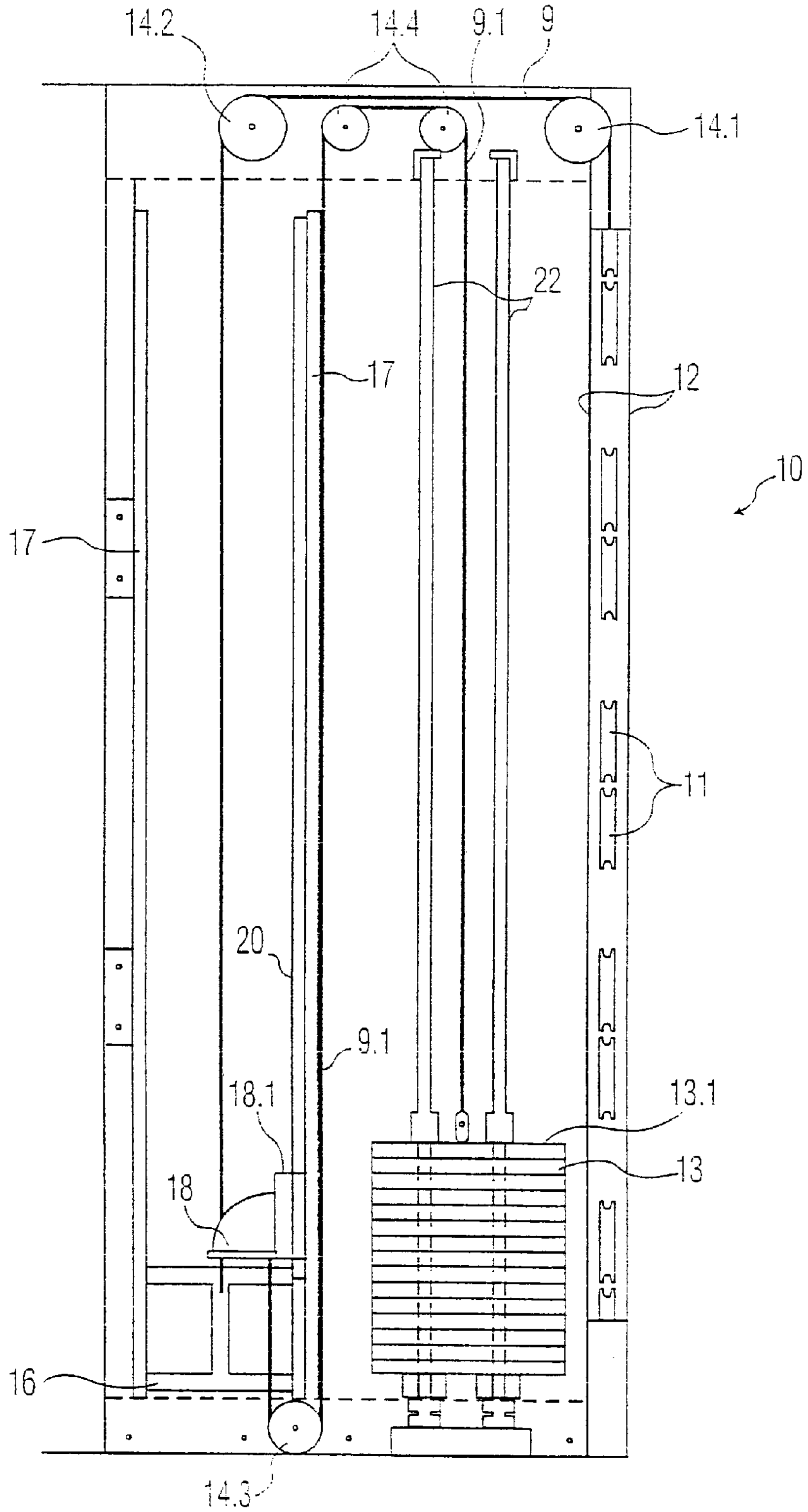
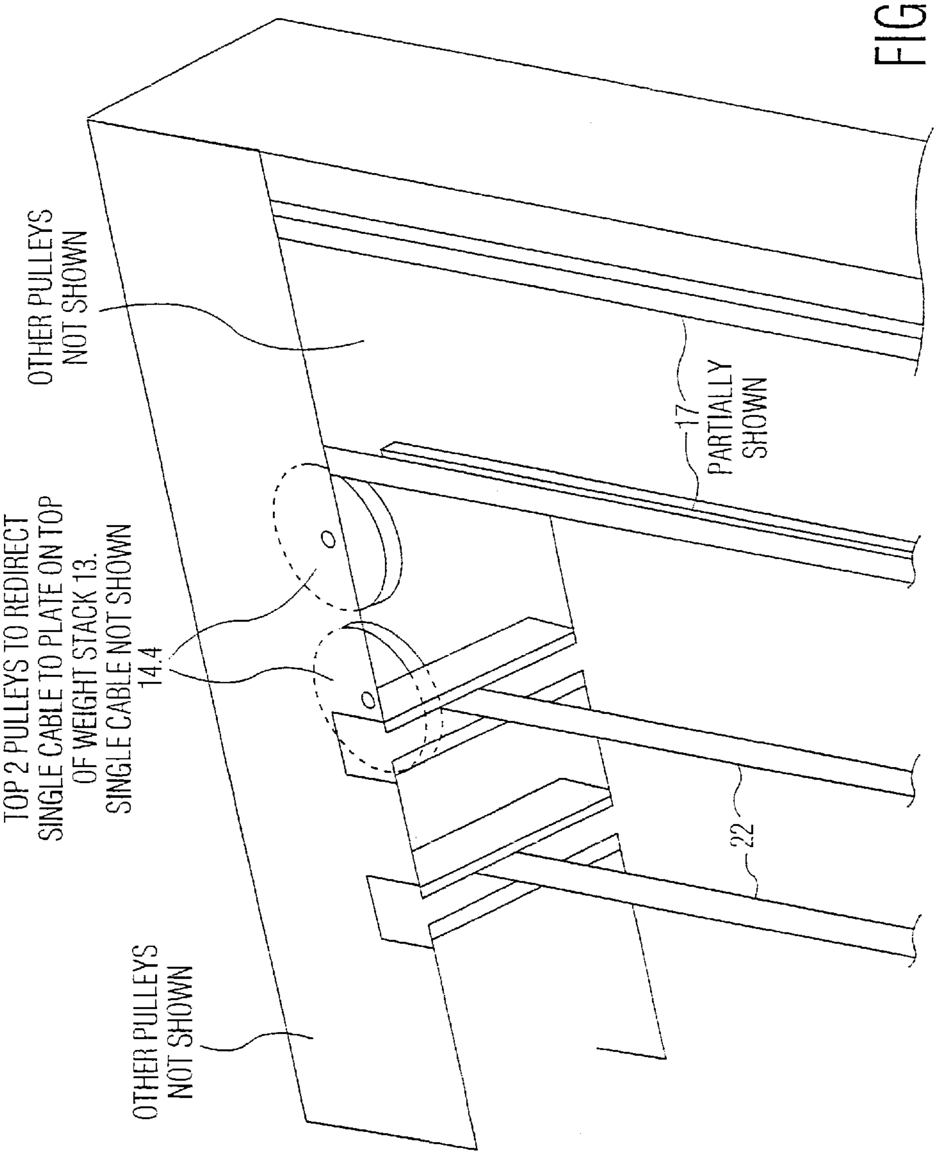
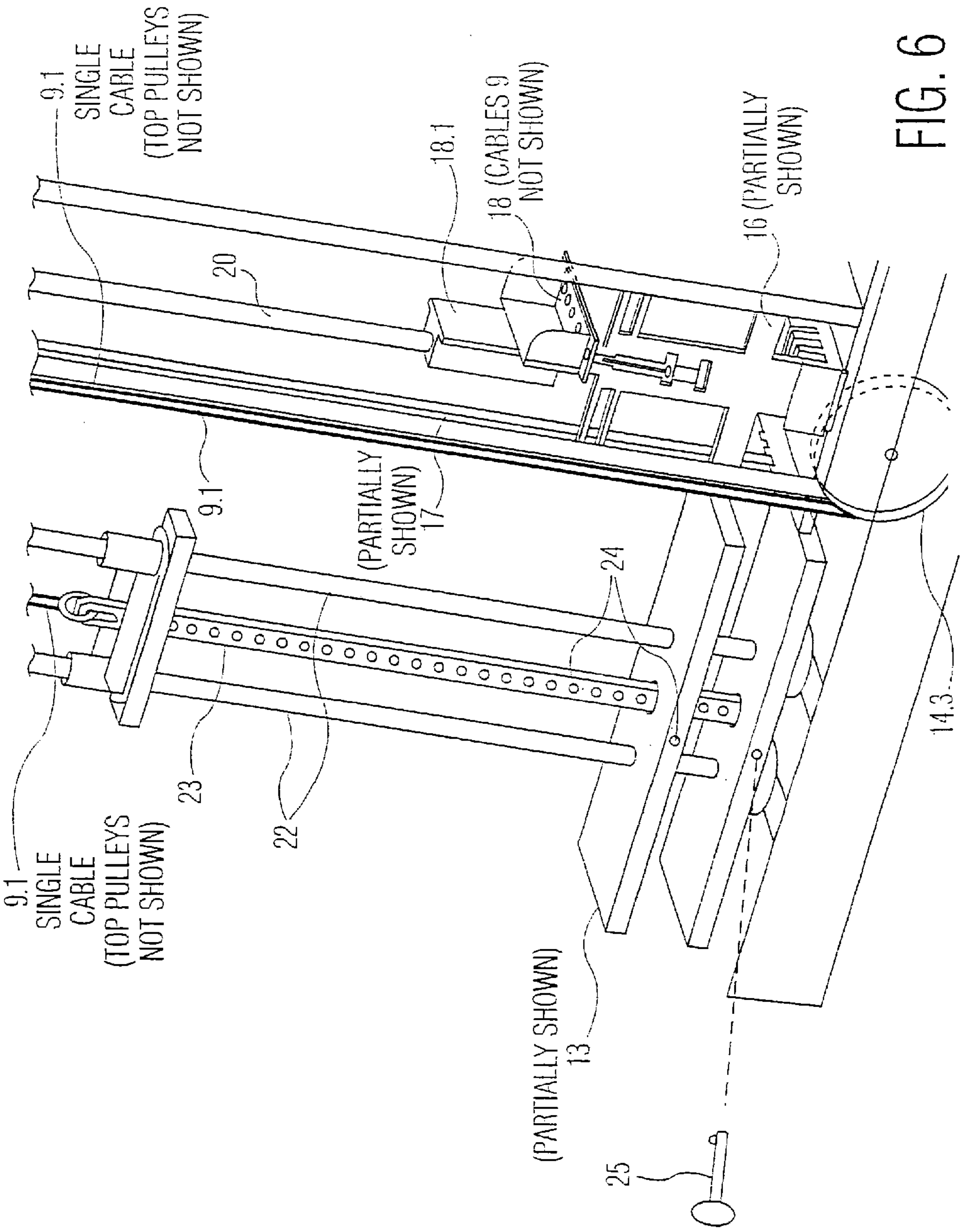


FIG. 4

FIG. 5


OTHER PULLEYS
NOT SHOWN
TOP 2 PULLEYS TO REDIRECT
SINGLE CABLE TO PLATE ON TOP
OF WEIGHT STACK 13.
SINGLE CABLE NOT SHOWN
14.4
17
PARTIALLY
SHOWN
22
OTHER PULLEYS
NOT SHOWN


9.1 SINGLE CABLE (TOP PULLEYS NOT SHOWN)
18.1
18 (CABLES 9 NOT SHOWN)
16 (PARTIALLY SHOWN)
20
9.1
(PARTIALLY SHOWN) 17
24
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9.1 SINGLE CABLE (TOP PULLEYS NOT SHOWN)
14.3
(PARTIALLY SHOWN) 13
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FIG. 6

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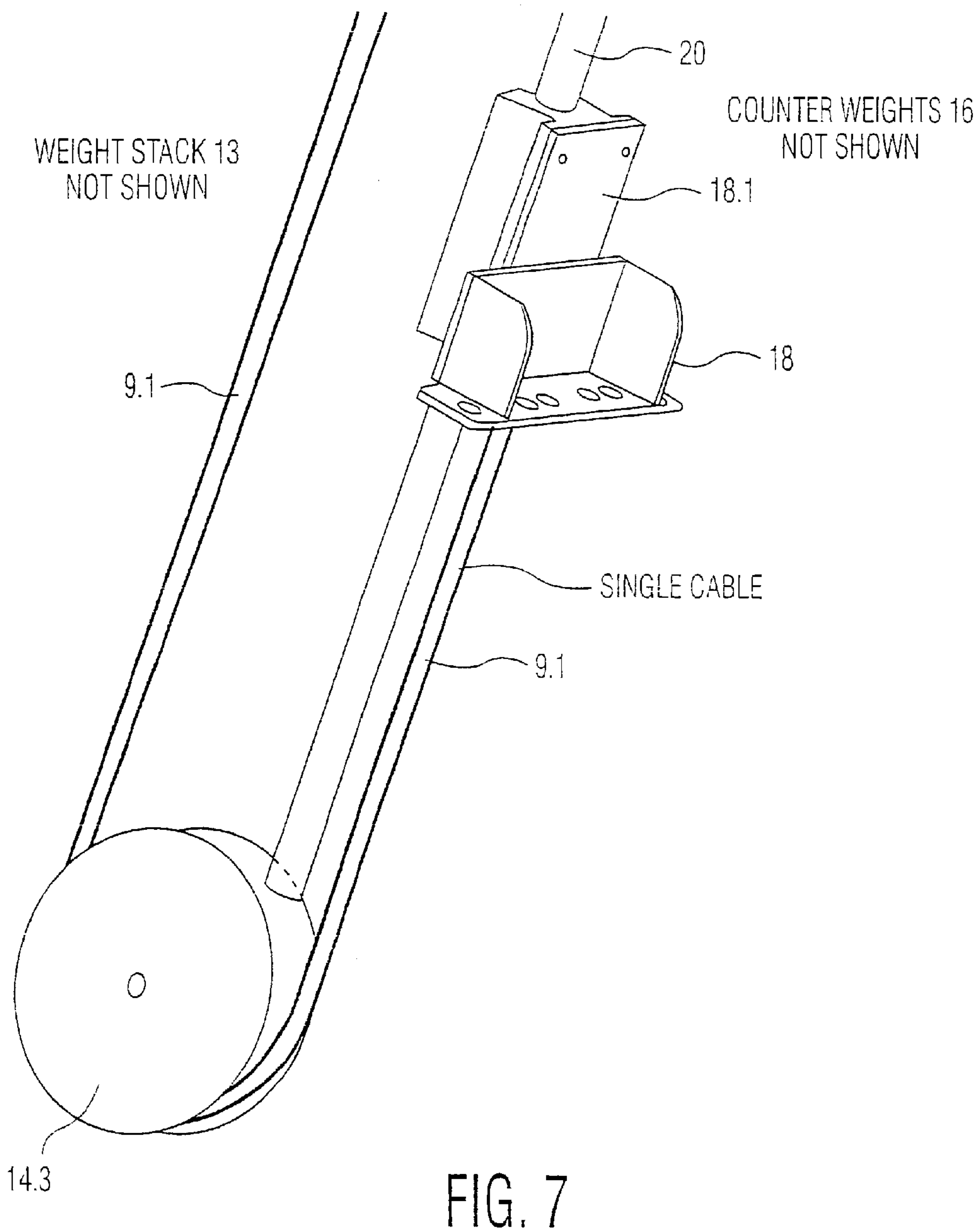

FIG. 7

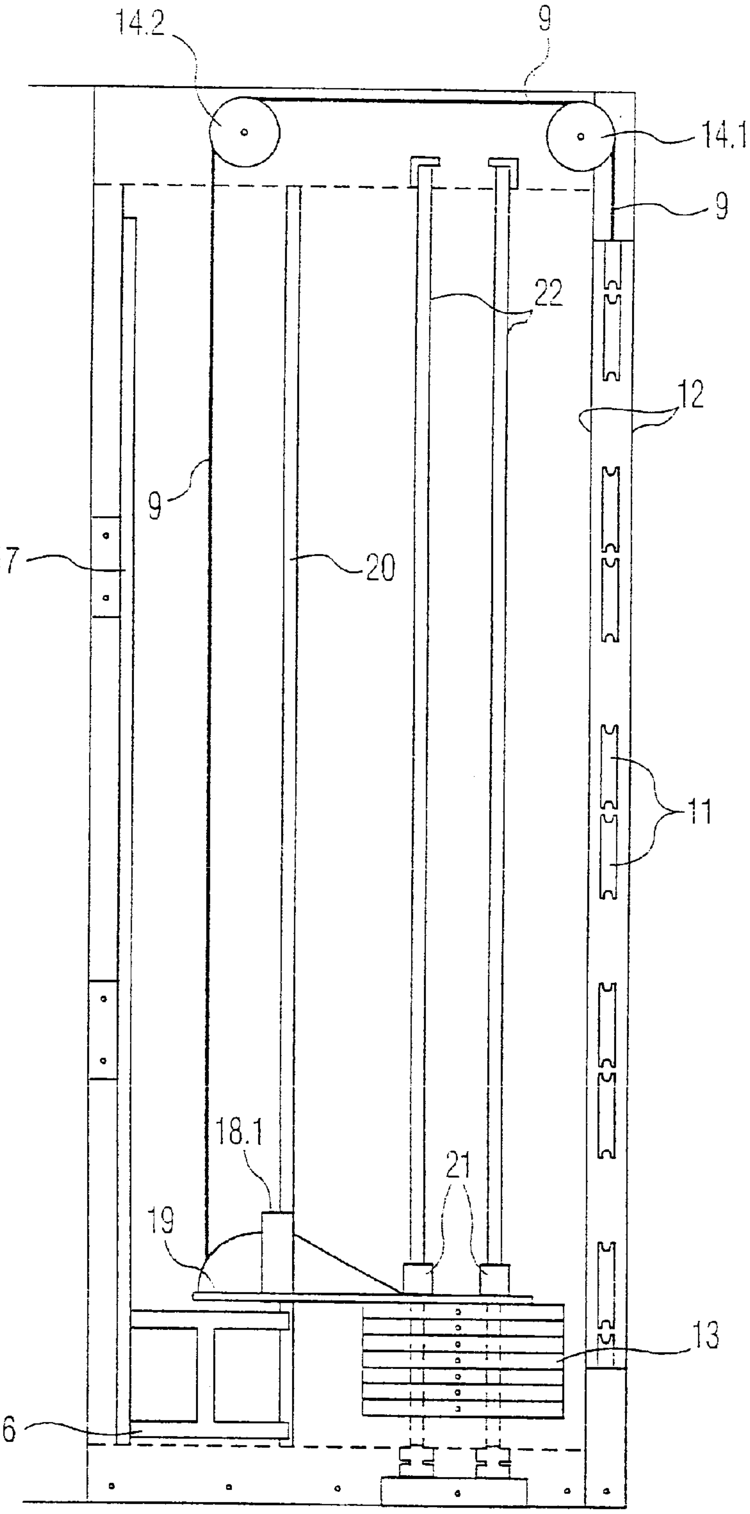

FIG. 8

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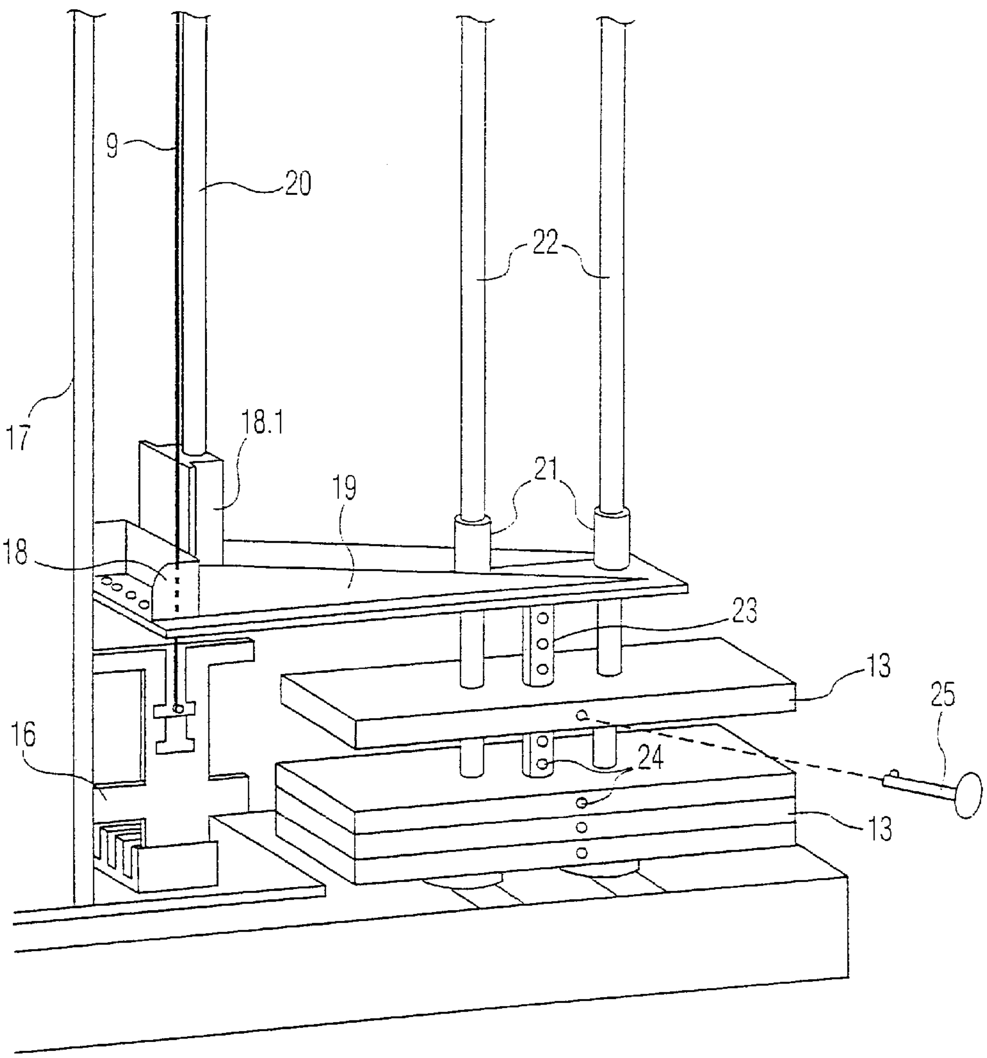

FIG. 9

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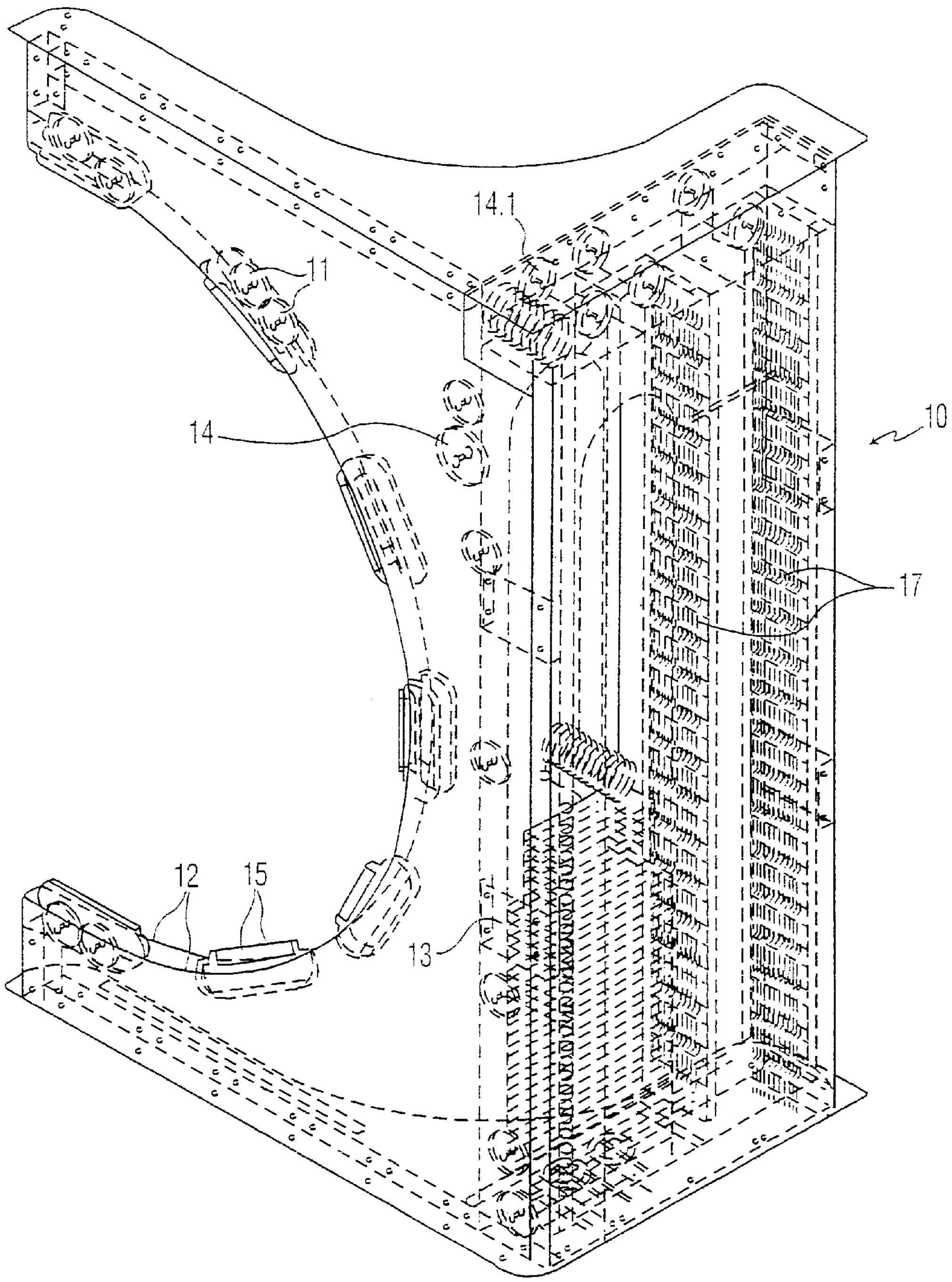


FIG. 10

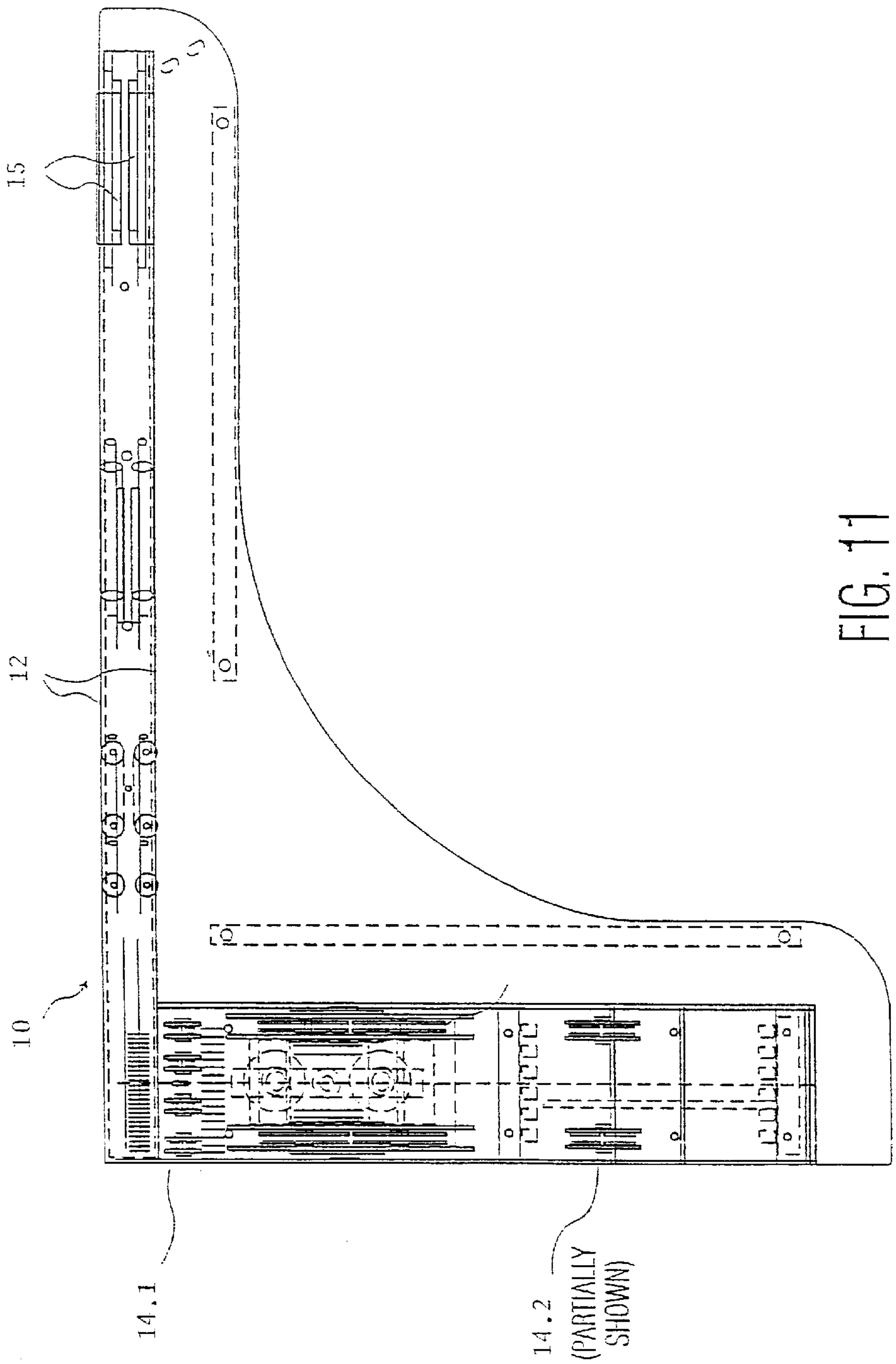
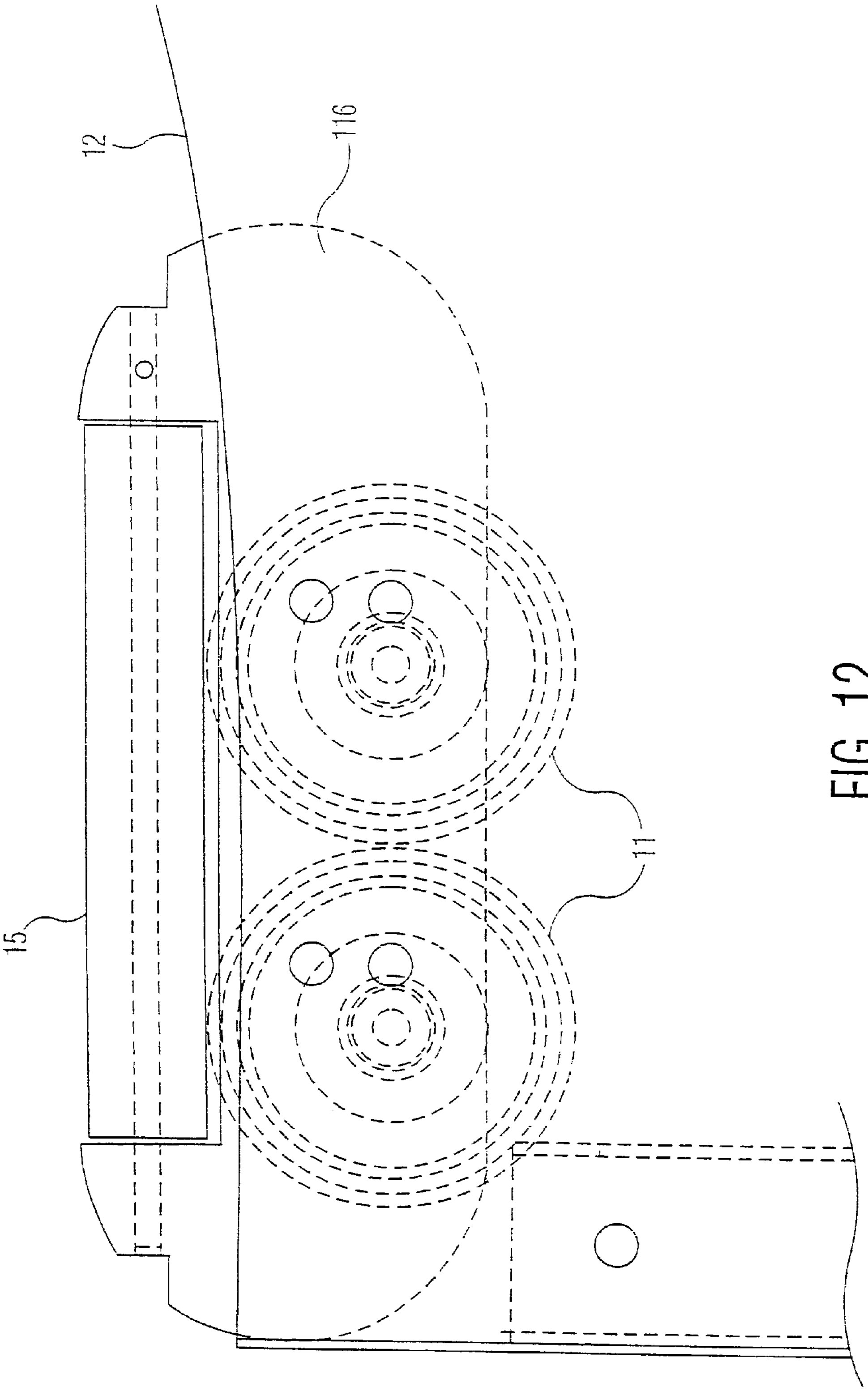


FIG. 11



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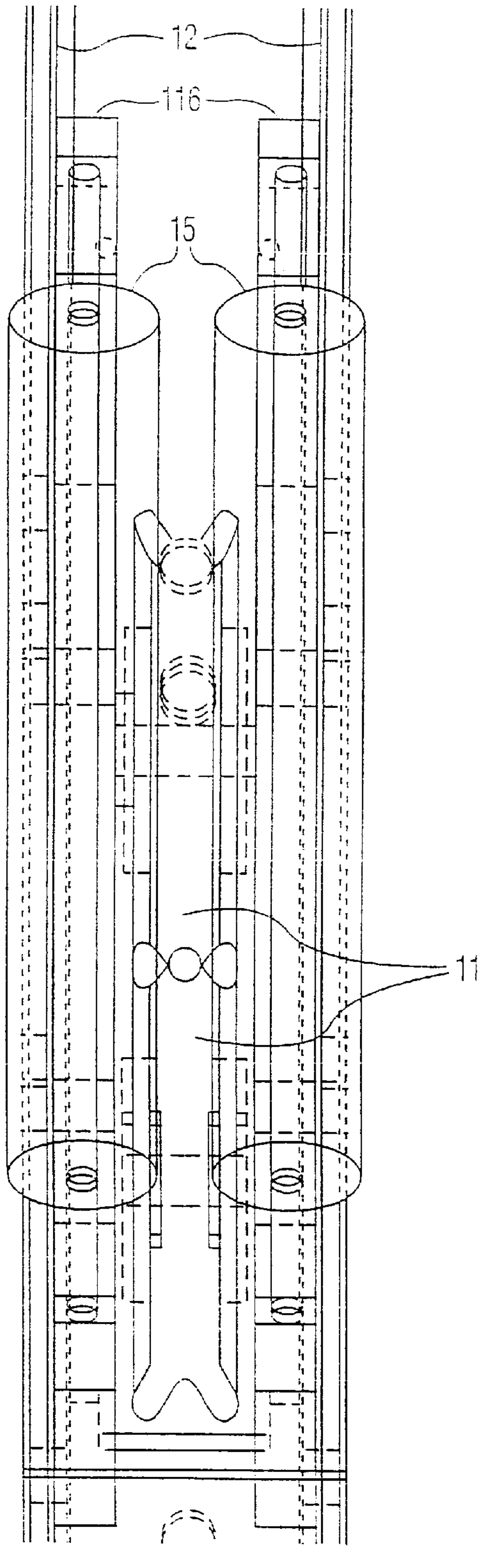

FIG. 13

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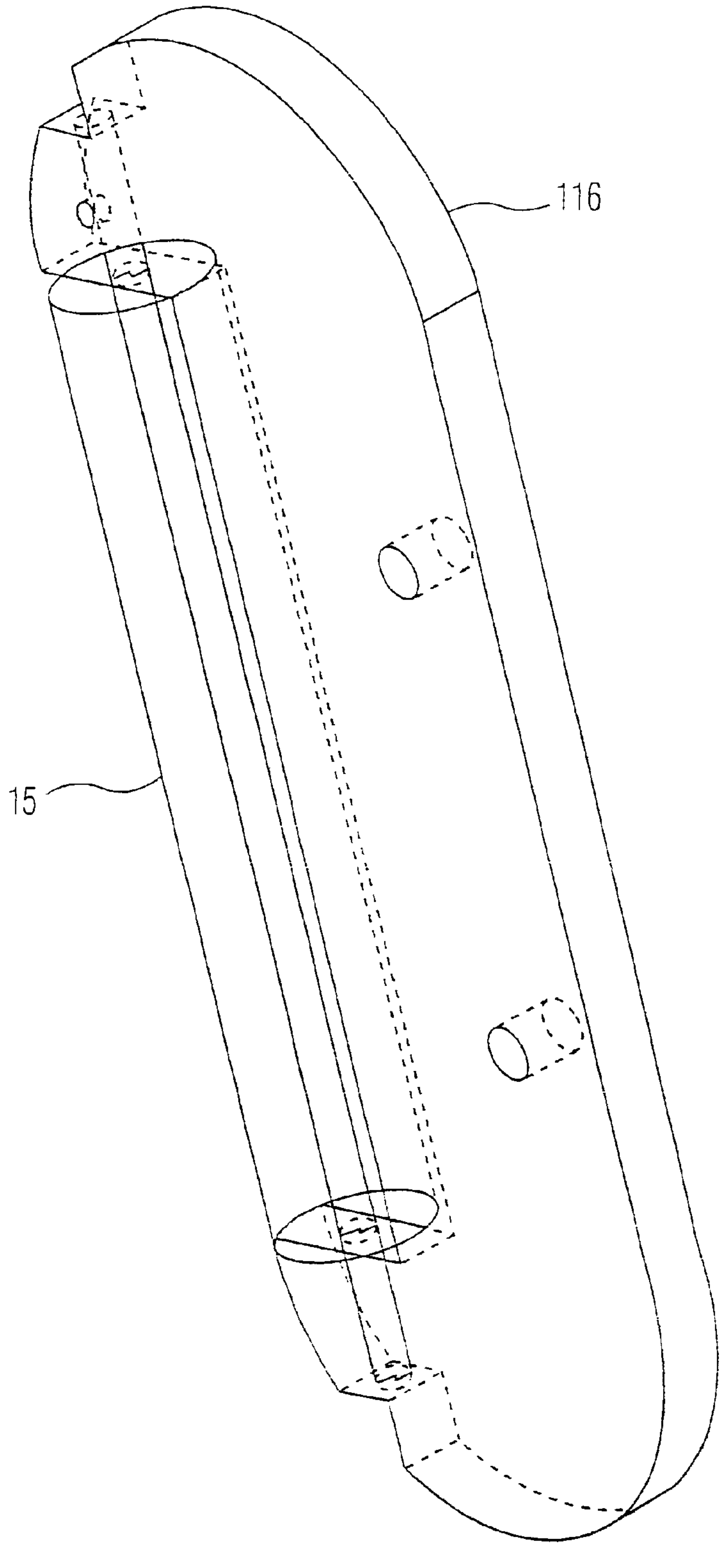

FIG. 14

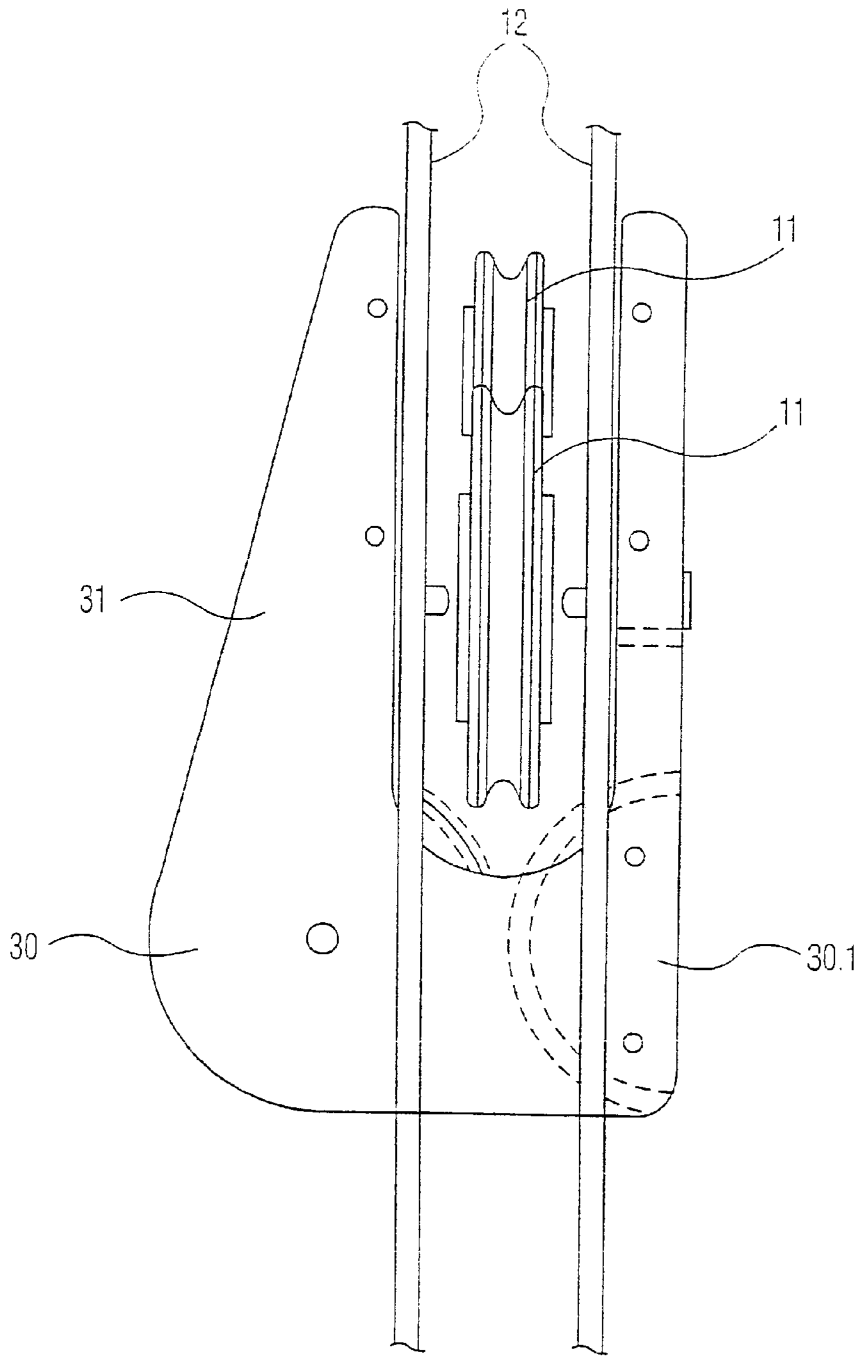

FIG. 15

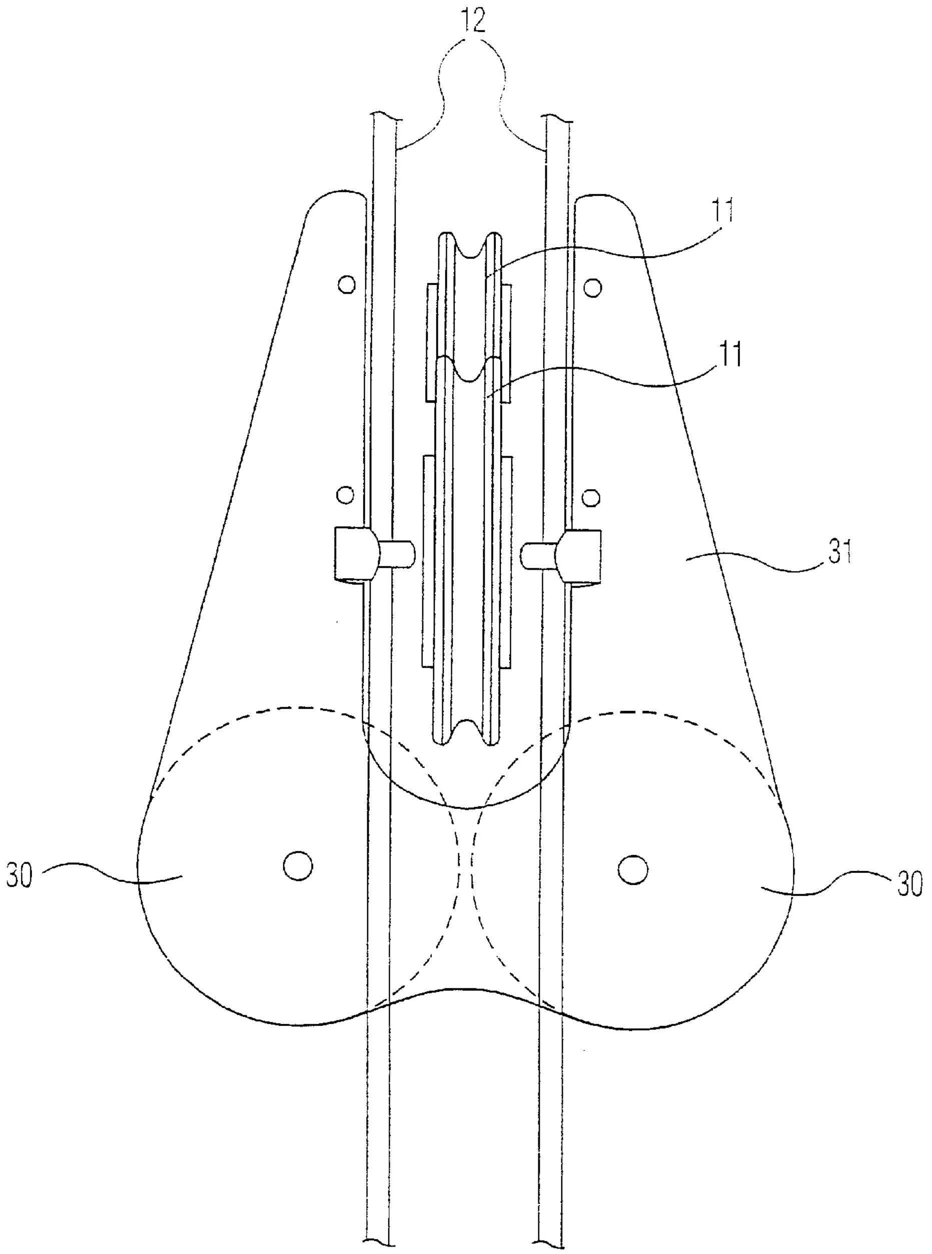

FIG. 16

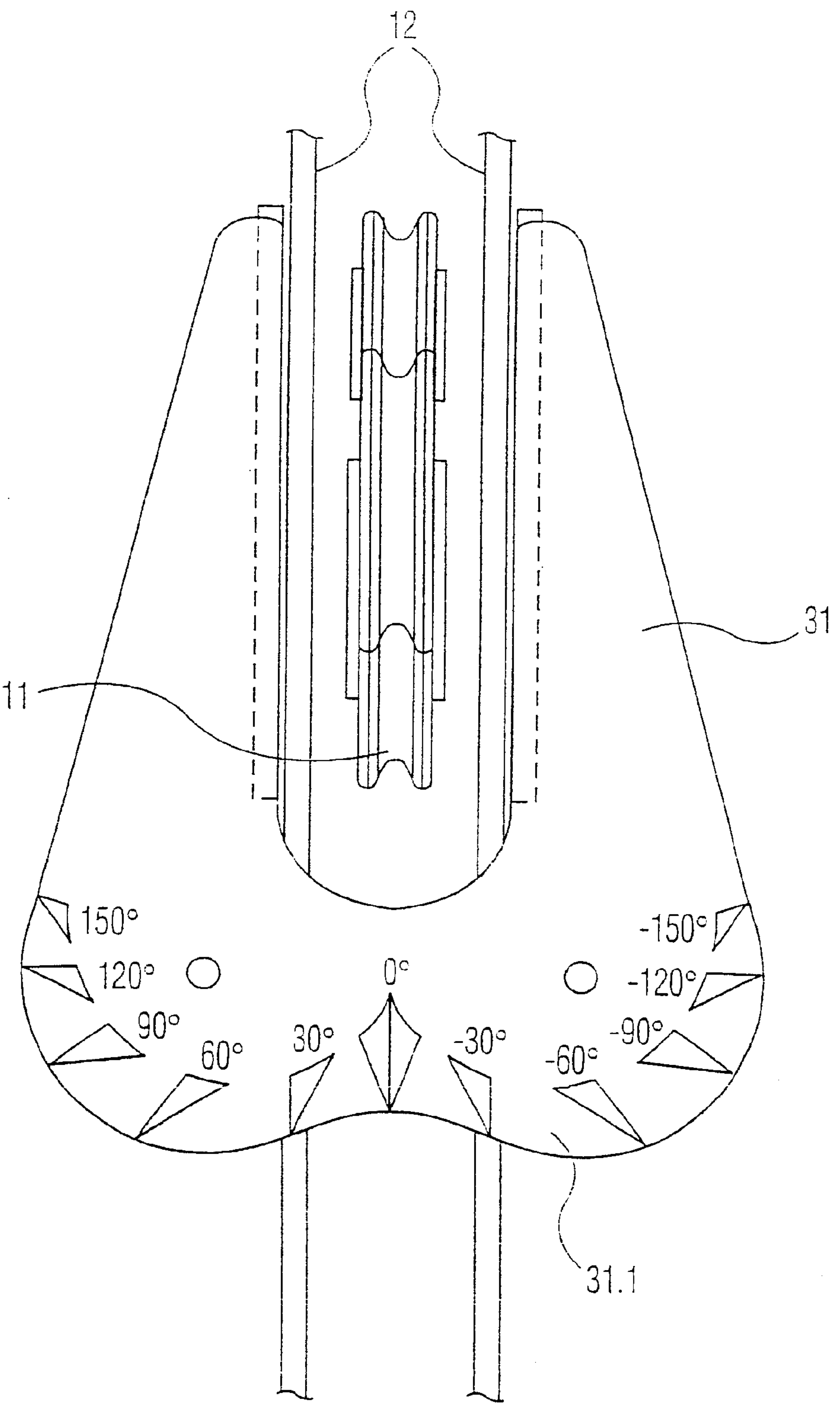

FIG. 17

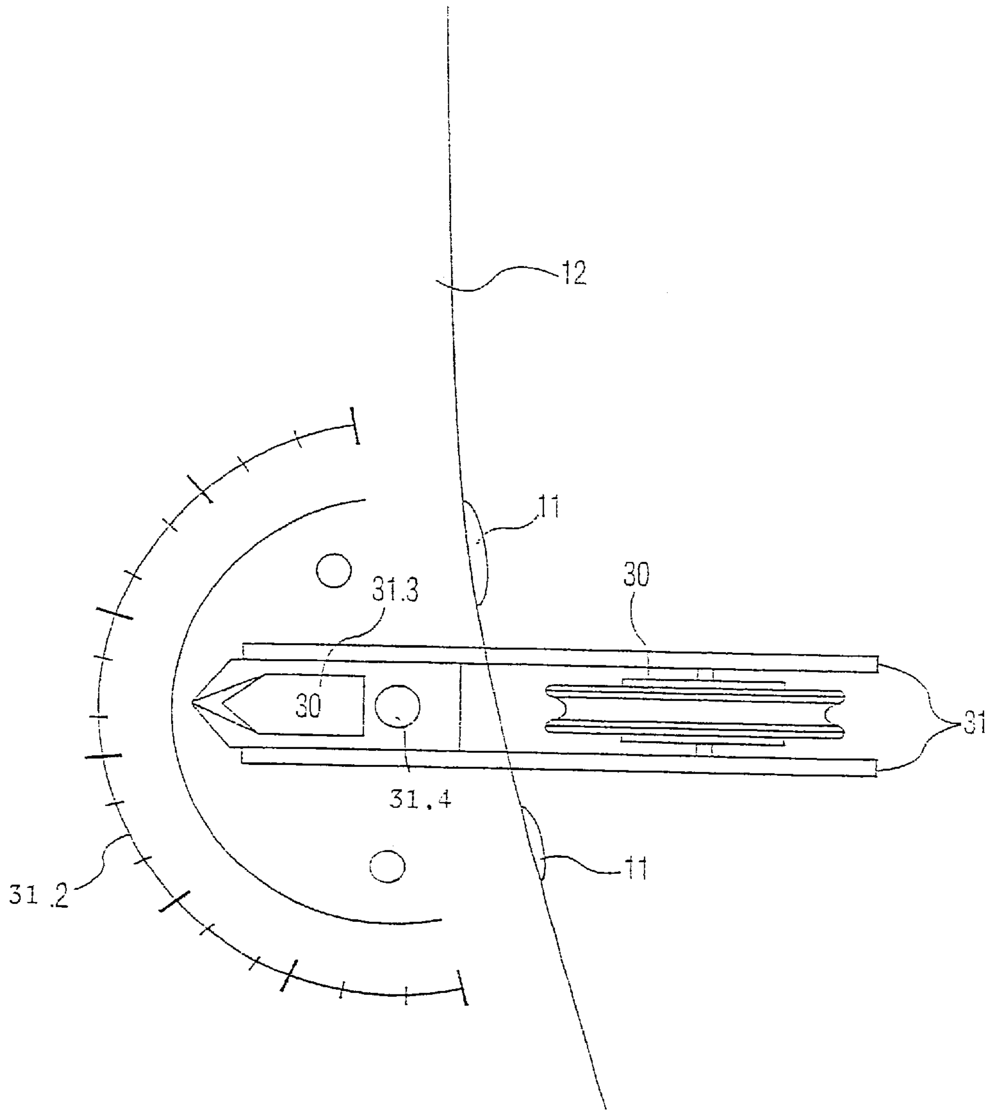

FIG. 18

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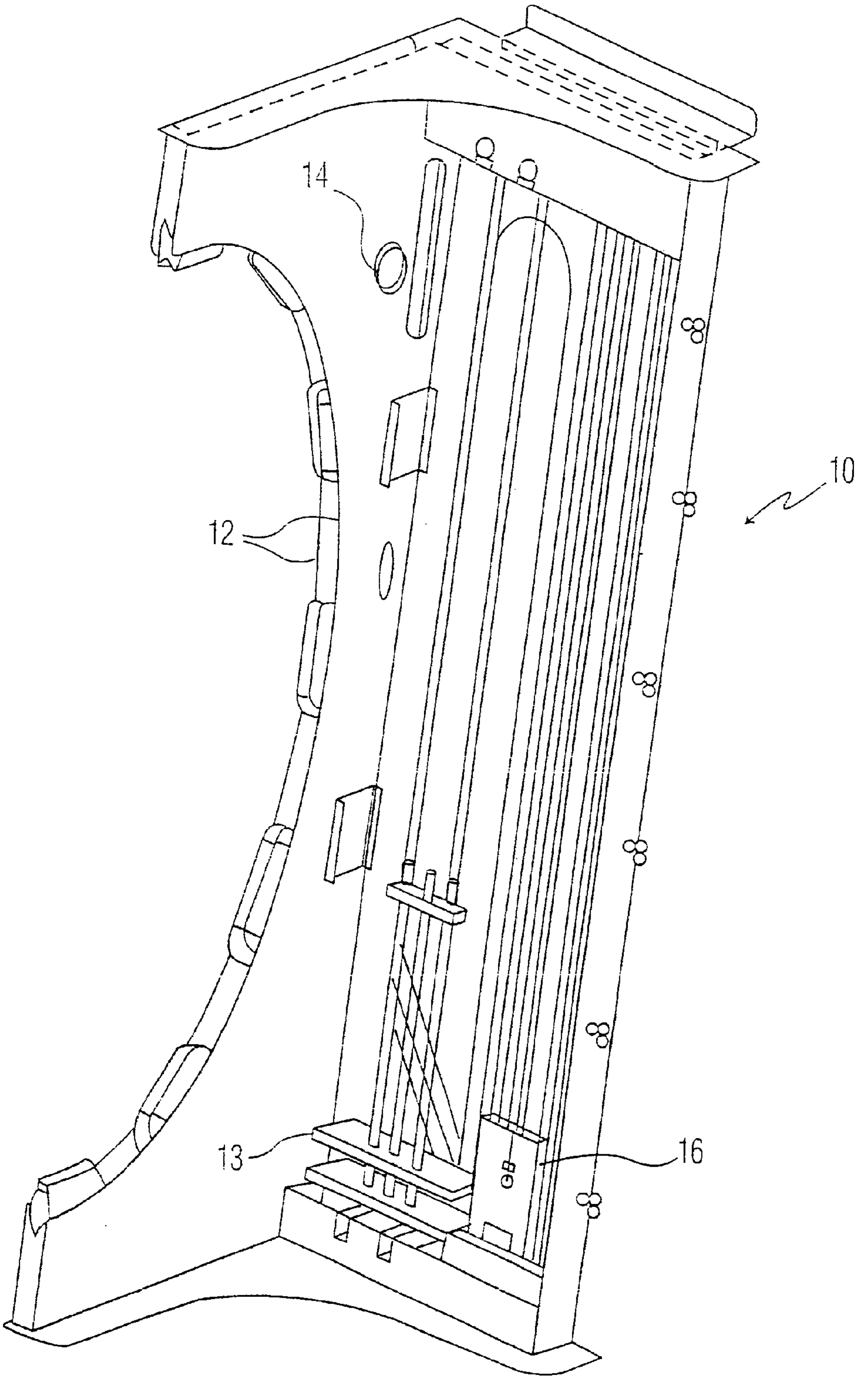


FIG. 19

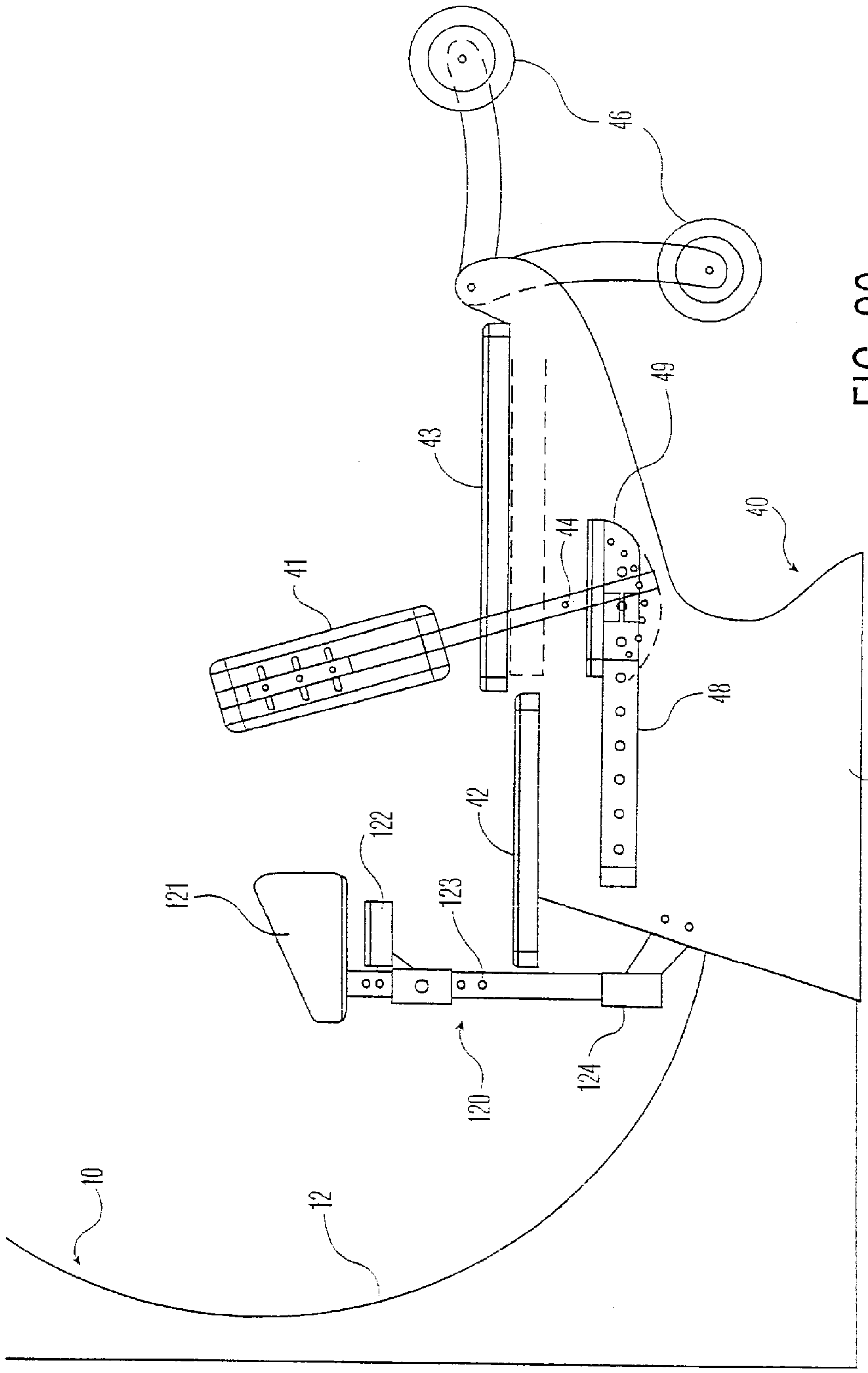


FIG. 20

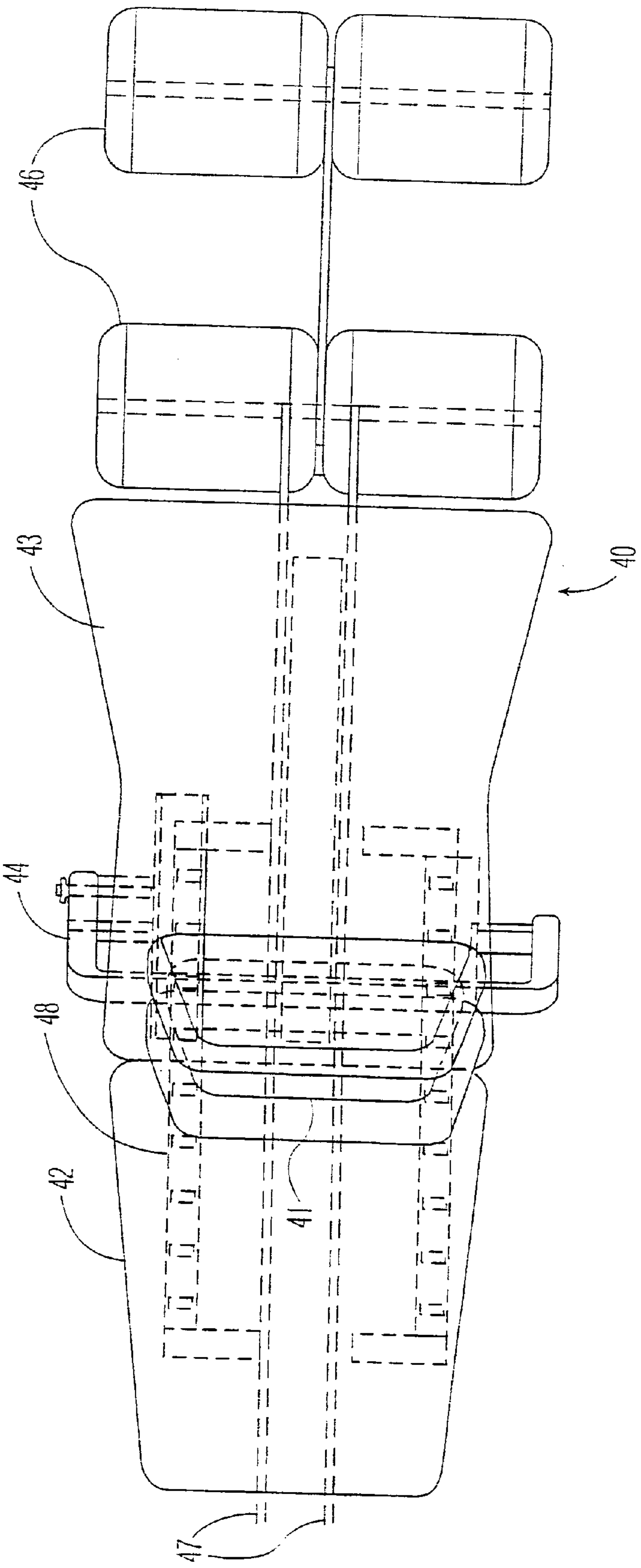


FIG. 21

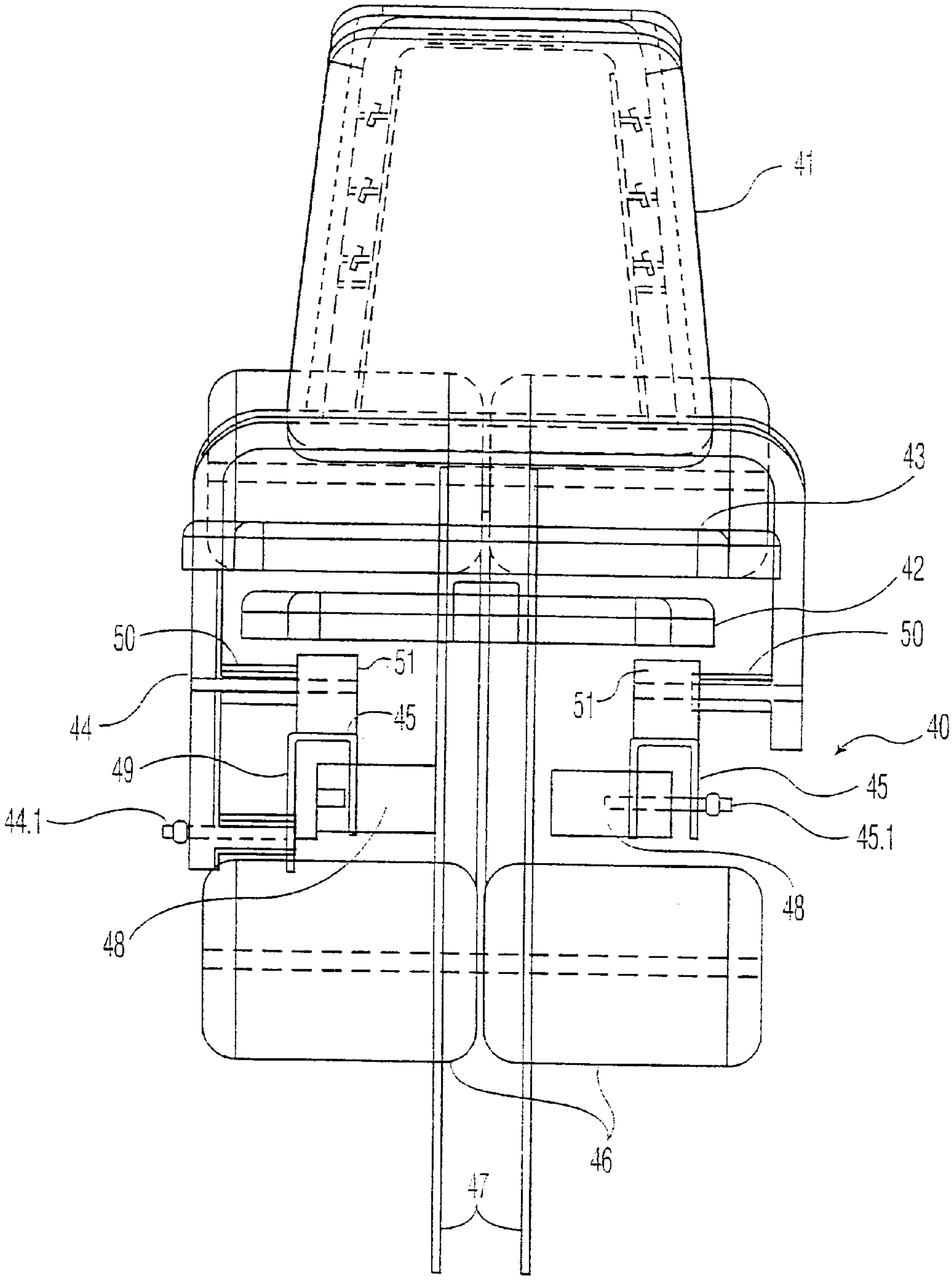
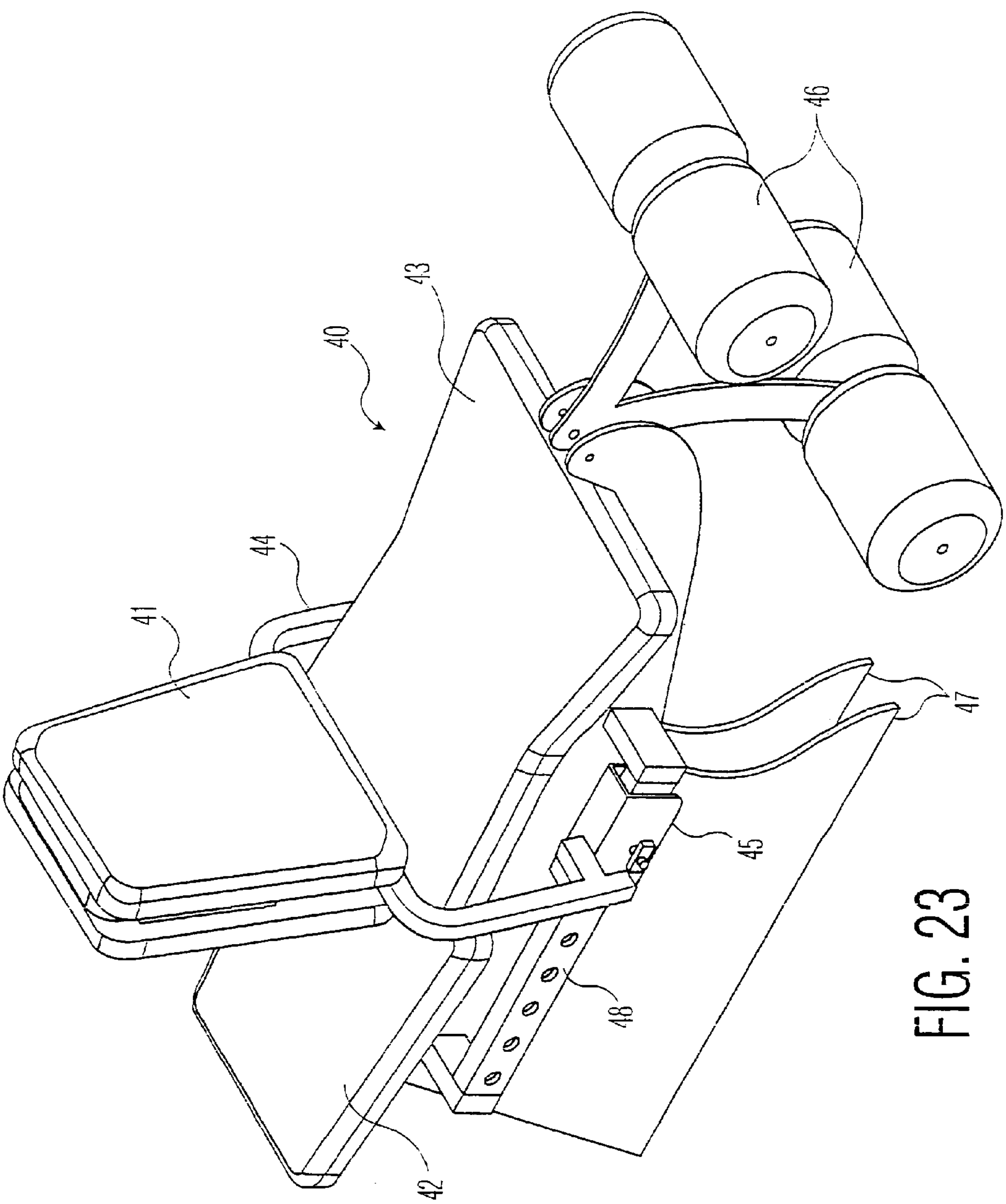


FIG. 22



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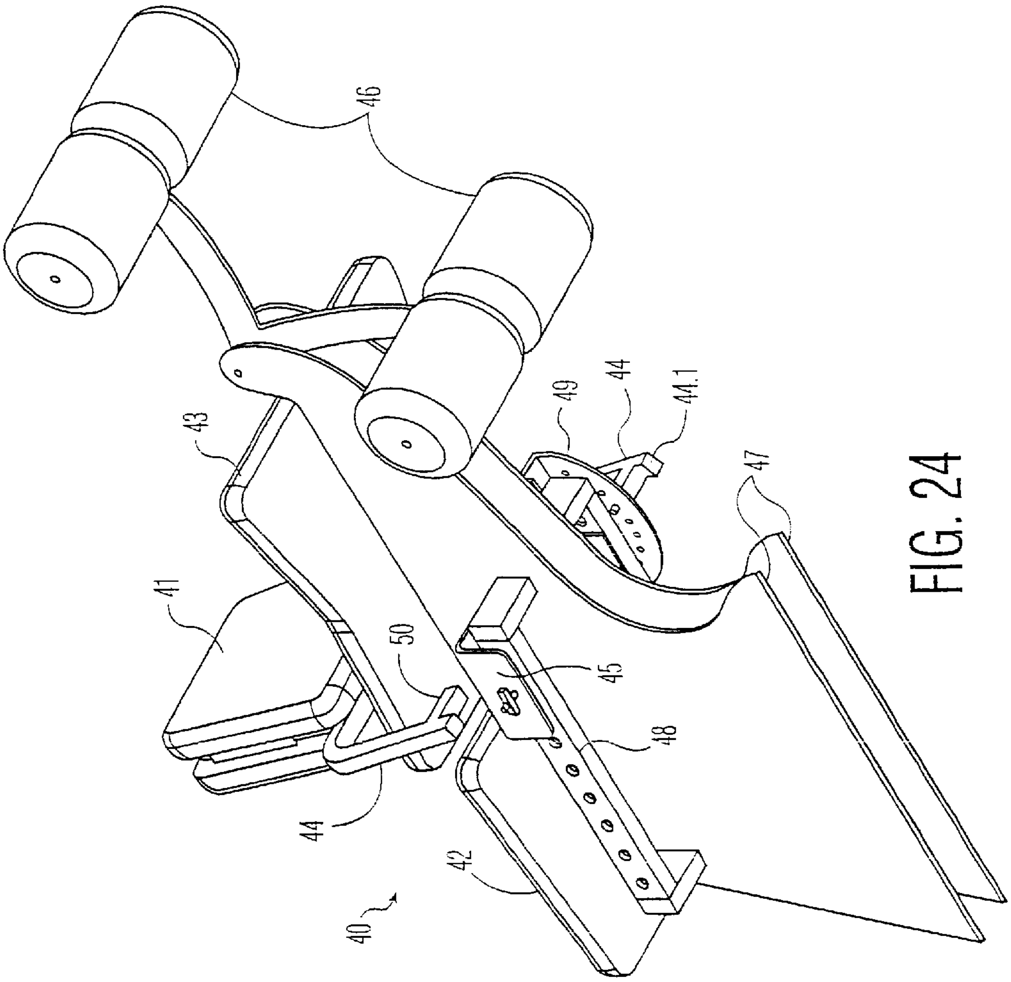

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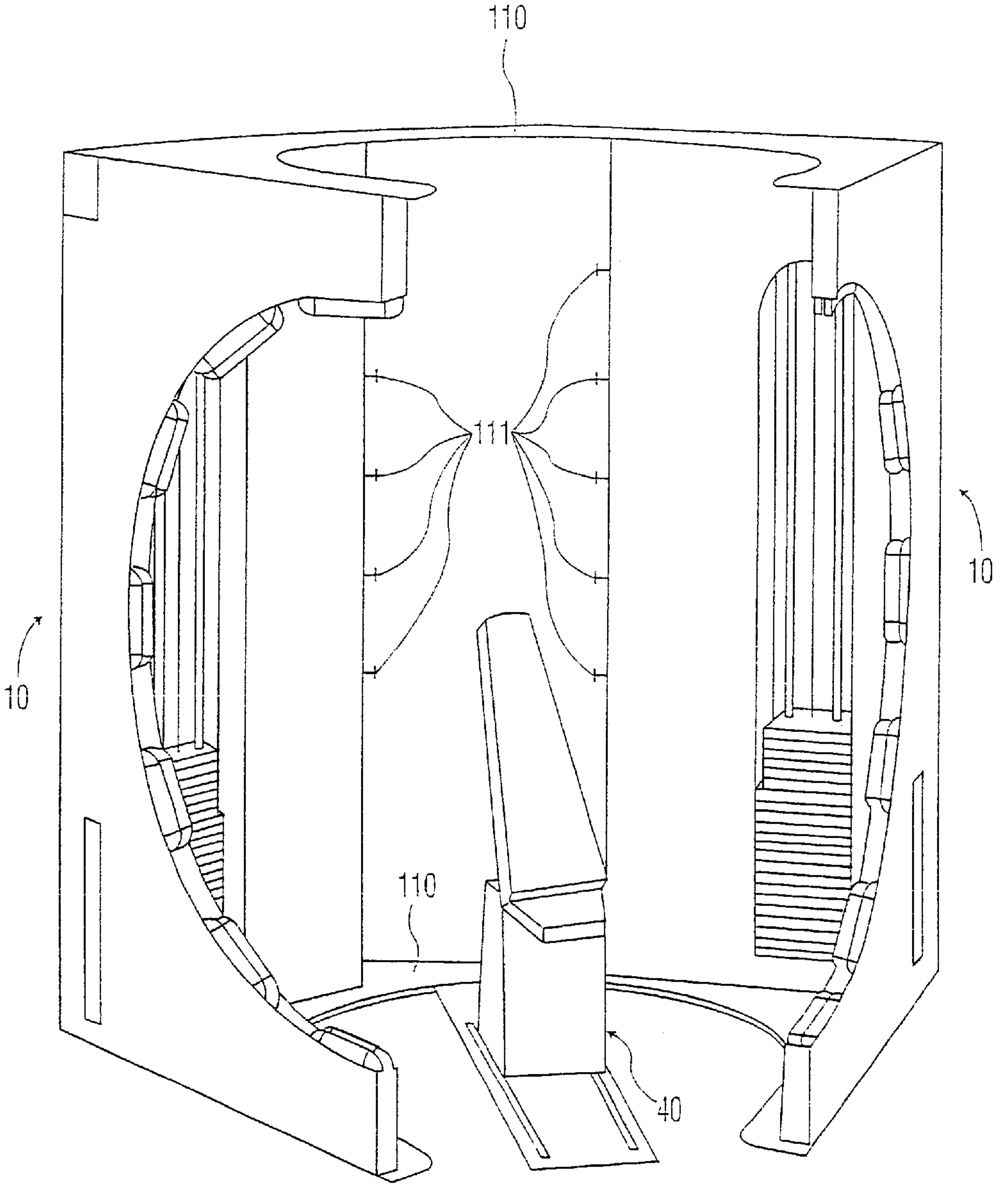

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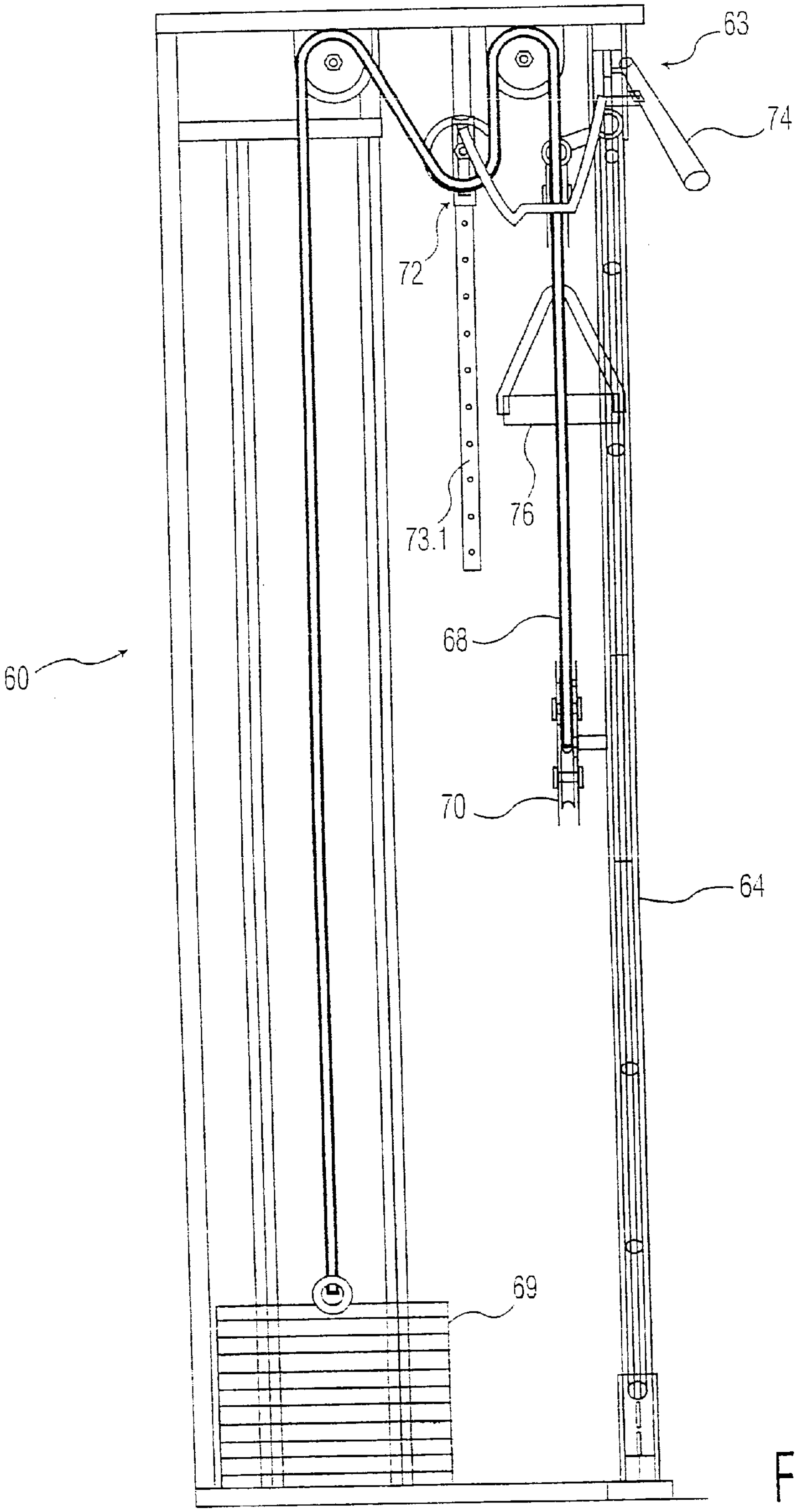

FIG. 26

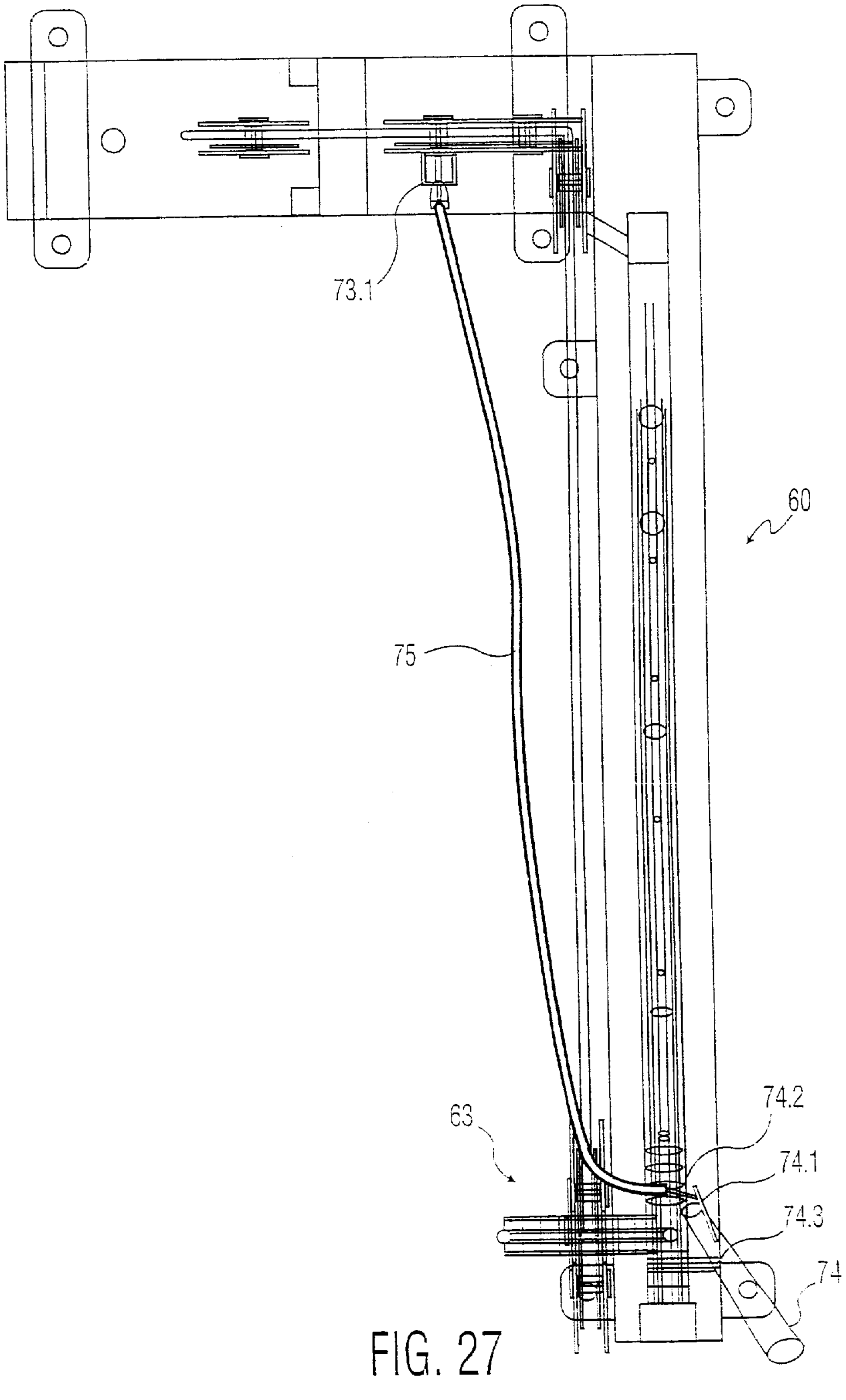

FIG. 27

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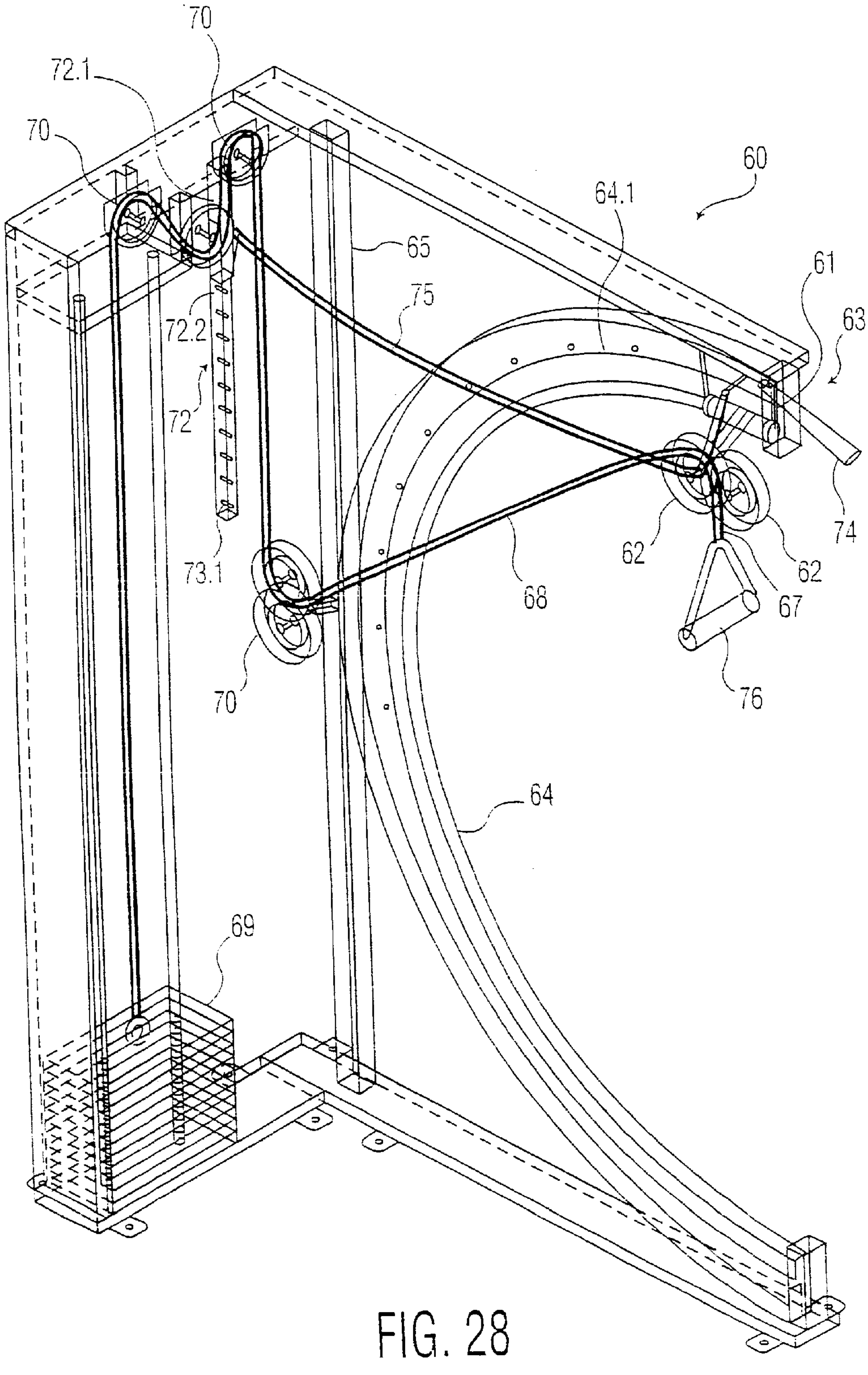

FIG. 28

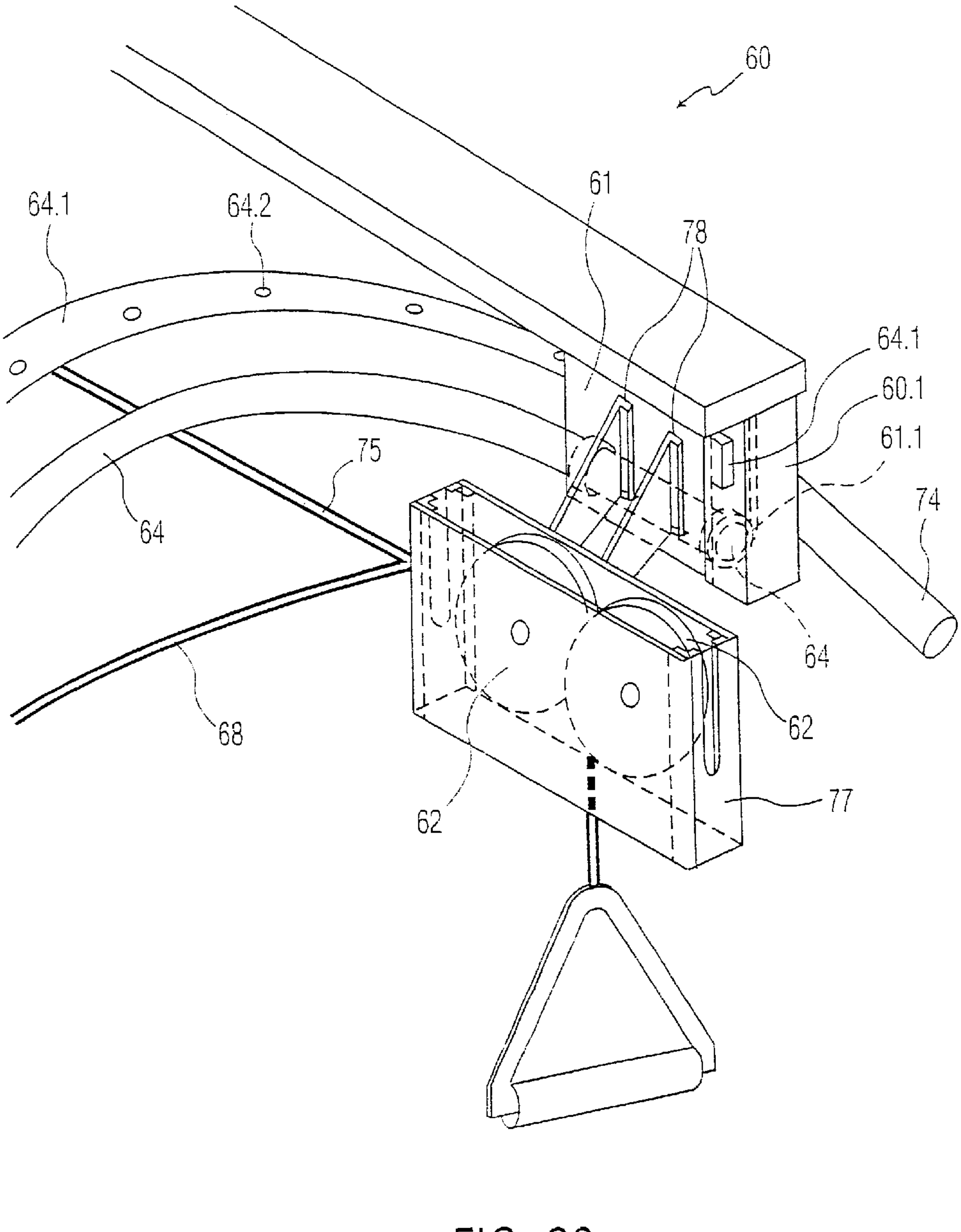

FIG. 29

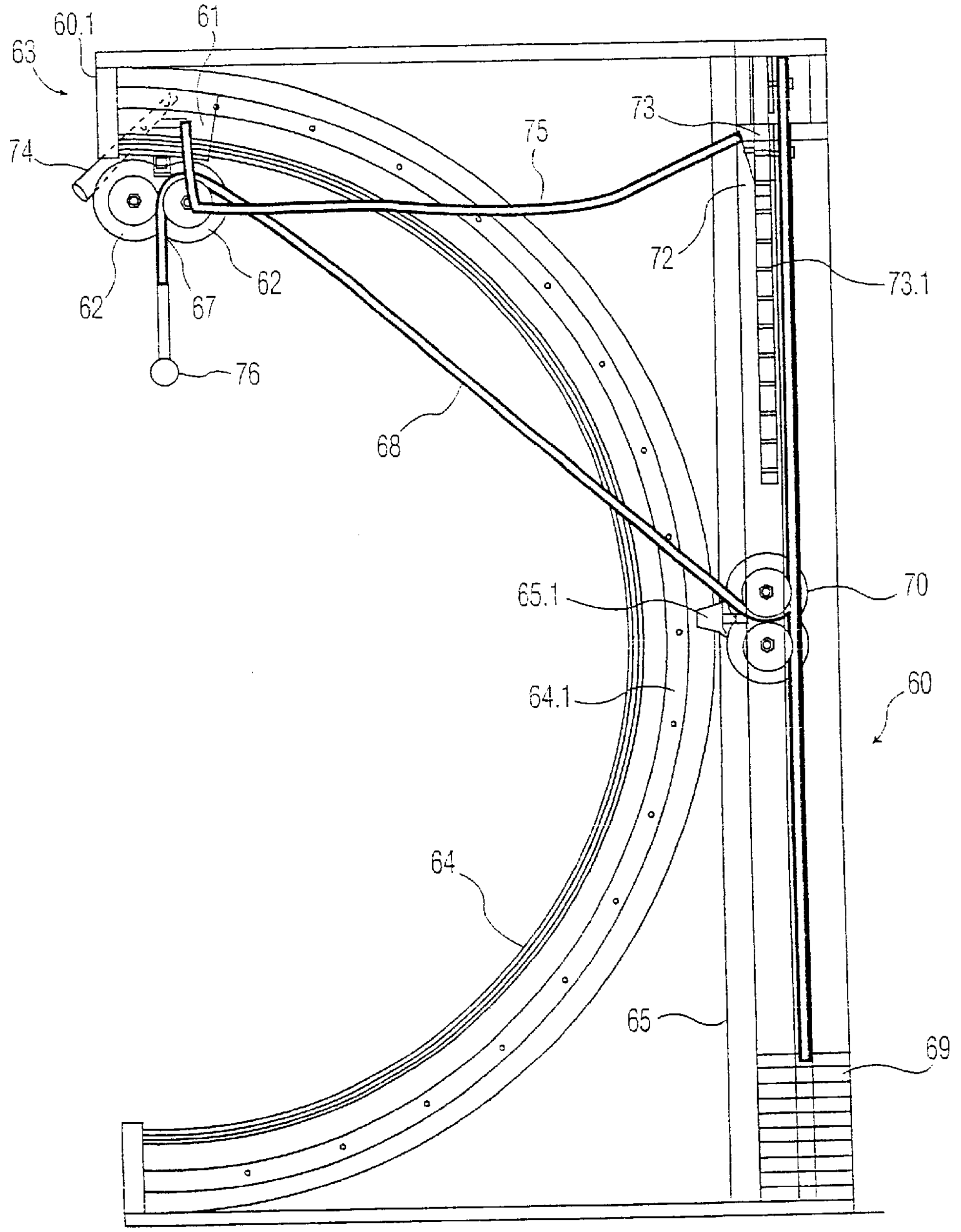

FIG. 30

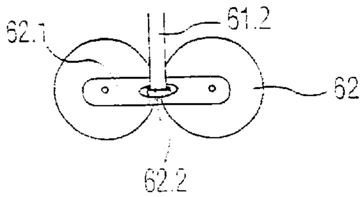

FIG. 30.1

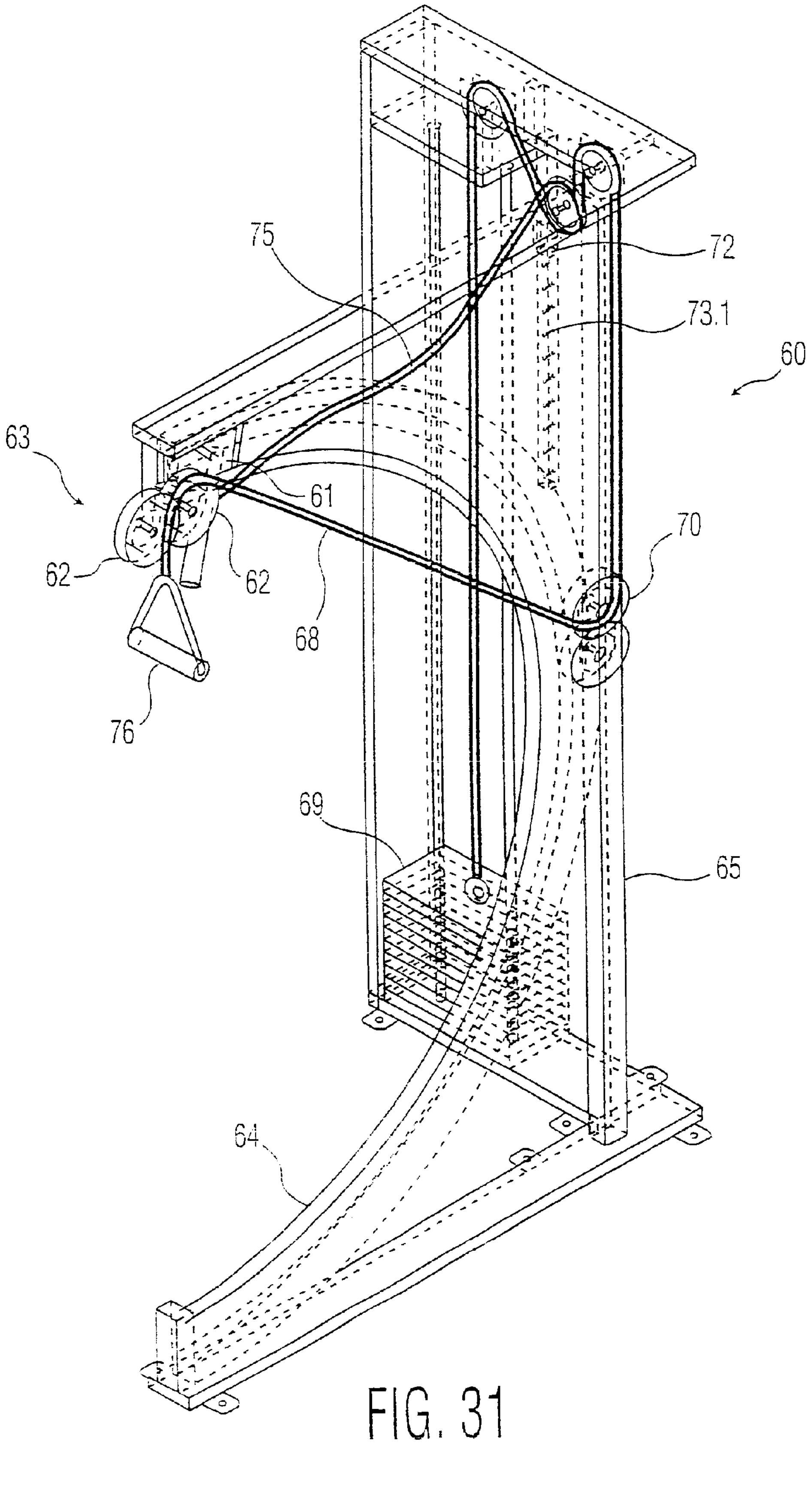

FIG. 31

EXERCISE APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

This application is related to, and claims priority from, U.S. Provisional Application No. 60/223,554, filed Aug. 6, 2000.

BACKGROUND OF THE INVENTION

The present invention relates to body exercise equipment.

Many units of exercise equipment have been disclosed or put into actual use in which a cable is drawn against a resistance source by an individual exercising with the equipment. Typically, these units of equipment include a handle attached to one end of a cable with a resistance source, such as weights, opposing the pulling of the cable. Different exercises can be performed by adjusting the vertical position at which the cable leaves the equipment. That adjustability, however, provides only a limited variety of exercises.

U.S. Pat. No. 4,603,855 discloses exercise equipment in which the handle, grasped by the individual using the equipment, can undergo three degrees of movement as it is positioned for a selected exercise. Although such equipment provides added adjustability, whereby many more exercises are possible, the particular arrangement disclosed in this patent, which includes mounting the handle on a telescoping arm, lacks sufficient strength and stability when constructed from conventional components or becomes very expensive to manufacture when special components are used to provide greater strength and stability.

In other exercise equipment sold by Eigin Exercise Equipment Corporation of Des Plaines, Ill., the handle grasped by the user is movable to the desired position by a trolley, which moves along a curved rod track. This equipment also provides added facility for a variety of different exercises. However, the framework support structure of this exercise equipment, particularly the single arced bar used to relocate the egress point, also provides only limited strength and stability when constructed from conventional components or becomes very expensive to manufacture when special components are used to provide greater strength and stability.

Only very light resistances can be used in this design or the framing and supports will bend and damage easily. It also requires the user to perform multiple steps to adjust the equipment for a desired exercise, particularly with regard to taking up the slack created in the cable when moving the egress point from place to place along the curved rod.

Other prior art that may be mentioned are the following U.S. Pat. Nos.:

3,306,611	4,549,733	4,898,381	
5,018,725	5,102,122	5,195,937	5,725,459

None of these is all that relevant to the present invention, except one, which is of some interest, i.e., U.S. Pat. No. 5,102,122. This patent uses a movable trolley that must be repositioned for each egress point for the handle from the exercise equipment required for a desired exercise position and two additional steps to release the locking mechanism for the cable take-up means before repositioning the trolley and to lock it again after it is in a new position.

Cable-cross units of equipment now currently available, provide a single step movable trolley that repositions an egress point along a straight bar, typically vertical in position, and typically have two such trolleys oriented side by side and spaced so a user can train in between them. Such designs do not optimize the interaction with basic human movement, do not provide a full 360-degree training environment in which to train, particularly limited in delivering resistance from training vectors overhead as well as from below. Also, when switching from a linear track design to a curved track, cable slack and changes in length relative to the egress point and the cable end that connects to the attachment create a serious problem. To correct this problem a counterweight system as shown in patent U.S. Pat. No. 5,102,122 can be used (but which calls for added steps to reposition the trolley due to the need to manually release the cable take-up means, unlock the trolley, move the trolley, relock the trolley and then relock the cable take-up means.)

SUMMARY OF THE INVENTION

The human body moves primarily in circular or rotating paths of motion as evidenced by Davinci's Study of Human Proportions. From a biomechanical standpoint, resistance exercise units of equipment designed with resistance delivery systems oriented along an arced pathway are inherently more biomechanically optimized than those that are not, thus offering tremendous advantages to the user. Also, the invention provides units of equipment that allow for the minimum number of adjustments, ease of use and orientation of the user to change the desired exercise parameters and shorten the work out time, the ability to preset or easily reset the attachments. The sequence of various exercises, are intuitively understood, safer to use, provide a greater range of resistance, service a wider range of users and a wider range of needs with the capability of providing an infinite number of resistance training possibilities and protocols, is handicapped and wheelchair accessible, provides a simple method to record their work and progress in three-dimensional space, is aesthetically pleasing and unique in appearance and provides a 360 degree workout environment.

It is an object of this invention to provide a line of advanced pulley system exercise units of equipment which provide the user all the benefits of free weight lifting yet are safer, more versatile and easier to use, are distinct in their product styling and design, can easily be customized to meet the demands of a wide variety of users with a wide variety of needs and provide a means whereby a user can perform more specific exercises on fewer units of equipment.

It is an object of this invention as well to provide more specifically tailored units of equipment using fewer parts.

It is another object of this invention to provide units of equipment that can also work in conjunction with a wide variety of attachments, with uniquely designed multipurpose benches and versatile, multipurpose chairs to greatly expand the variety of options they provide for the user and to appeal to the widest possible range of users.

It is also an object of this invention to allow for only one adjustment to be made, the selection of the desired resistance, in order to exercise any part of the body (excluding, of course, the changing of an attachment).

It is yet another object of this invention to provide means to position two or more fixed egress pulley means positioned along a variety of single or dual walls or framed structure, or single or dual tracks, rails, tubes or cylinders or other support means of a variety of shapes other than just a straight line (yet could include a variety of straight line and curved combinations) relative to a user pulling on a handle connected to a connecting means attached to a resistance means and having one or more cable take-up means which enable the user to perform an infinite variety of exercises for muscular development or rehabilitation on more ergonomically efficient, optimally comfortable, easier to use and understand, resistance exercise devices.

It is an object of this invention to provide safer and more stable and user-friendly resistance units of equipment, which are more economically feasible to manufacture by maximizing economies of scale due to more standardization of parts that can be used to create a wider variety of units of equipment and which exercise both the prime movers as well as the stabilizer muscles in the human body in an infinitely positionable and unrestrained way.

It is a further object of this invention to provide designs that also allow for the development of Total Body units which use a standard set of parts which can be used to create a whole line of exercise units of equipment utilizing various combinations and mixes of egress points along one or two of the various shaped paths as they are positioned relative to the user in unilateral and bilateral formations which themselves can be fixed or move relative to themselves to create varying points of egress for the user to grab onto attachments connected to the connector means allowing for the creation of a line of units of equipment which enables the user to train specific body parts in a wider variety of ways.

It is a still further object of this invention to allow the user a means to record which training vector in three-dimensional space they are exercising in so they can record and repeat their movement patterns each time they use the units of equipment.

These objects and others that will become apparent from the following specification are achieved by exercise equipment including a housing having a curved path, multiple pairs of pulleys positioned along the curved path, each pair of pulleys having passed between them a cable, far from the proximal end of which is the distal end of the cable being attached to a source of resistance and the proximal ends being located outside the curved path and attached to a means that enables the user to exert force against the resistance. The resistance may be variable. The resistance may be a set of weights, for example. A set of counterweights may be used to act as a cable-take-up means when different egress points along the curved track are utilized.

An economy model of the exercise equipment includes a framed housing having a curved track defining a prescribed curved path, a pair of pulleys on a movable trolley repositionable along the curved path, and having passed between them a cable, the proximal end of which is located outside the curved track and attached to a means that enables the user to exert force against the resistance, to which the distal end of the cable is attached. The resistance may be variable. The resistance may be a set of weights. A set of counterweights may be used to act as a cable-take-up means when different egress points along the curved track are utilized.

Means for allowing the user to exercise force against a resistance may be a handle, strap, belt, rope, bar or any other means that are useful in exercising.

The exercise equipment is arranged for engagement by one arm or one leg or one body part at a time. If both arms or both legs or one of each or more than one body part are to engage the equipment simultaneously, two points of force application (i.e., universal connectors), suitably located, are provided and the overall exercise equipment has two parts. The two parts can be separate units, placed side-by-side, parallel or at selected relative angles, or they can be integrated into a unitary construction. Although in the following description of the present invention reference is made to engagement by and exercise of the arms and legs, by the use of suitable attachments to the universal connectors, other body parts such as the torso, neck, hips, shoulders, chest and back also can be engaged and exercised.

In contrast to the prior art, multiple fixed egress points of the present invention provide a multitude of egress points for handles. It is merely necessary to grasp a handle at the desired egress point—no repositioning is necessary.

The movable trolley equipment of the present invention allows for one step to reposition a movable trolley along an arced track and provides a sturdy, less expensive frame and a single track for the trolley to move along to relocate the egress point from which to train with both light and heavy resistances. The invention can comprise a mechanically or electronically actuated brake using levers, cables, pins, pads, or other braking means that is activated when the release mechanism for repositioning the trolley is used. When the mechanism to reposition the trolley is activated, the brake is released on the cable take-up means. When the trolley is repositioned and locked in place the brake is simultaneously locked. The brake cable and cable take-up mechanism are oriented in such a way that when the trolley is moved along the arced path, the cable length remains constant with regards to the egress point and the cable end that connects to the attachment. This brake and cable take-up system can be applied in both a fixed end and closed loop cable system. It can also be used when the take-up means is between the point of egress and the resistance means, or past the end of the resistance means as shown in patent U.S. Pat. No. 5,102,122.

There may be additional exercise equipment positioned near the exercise equipment of the invention for either style, i.e., the fixed point system or the movable trolley system. Two units of equipment are capable of being used simultaneously by a single user exercising two limbs or other parts of his or her body simultaneously or by two users simultaneously. The two units of equipment may be placed side-by-side parallel or at selected relative angles. They may be integrated into a unitary construction and may utilize a multifunctional chair or bench, which can be positioned to cooperatively function with the exercise equipment. The curved tracts may also be affixed to frames, which allow each to rotate vertically around to create a 360-degree totally repositionable workout environment about the user while he/she is positioned between the curved tracts as shown in U.S. Pat. No. 5,102,122.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an x-ray side top isometric view of one embodiment of exercise equipment constructed in accordance with the present invention.

FIG. **2** is a simplified x-ray side view of the exercise equipment in FIG. **1**.

FIG. **3** is more detailed x-ray side view of the exercise equipment in FIG. **1**.

FIG. **4** is an x-ray front view of a portion of the exercise equipment in FIG. **1**.

FIG. **5** is a partial isometric view of the top of the equipment.

FIG. **6** is a partial isometric view of the bottom of the equipment.

FIG. **7** is an enlarged view of part of FIG. **6**.

FIG. **8** shows a variation of FIG. **4**.

FIG. **9** illustrates a variation of the bottom of the equipment **10** shown in FIG. **6**.

FIG. **10** is an x-ray top isometric view of the exercise equipment constructed in accordance with the present invention.

FIG. **11** is an x-ray top view of the exercise equipment.

FIG. **12** is an x-ray side view of one pair of pulleys and a roller that is rotatably set in a bracket, which in turn is set in a curved track.

FIG. **13** is an x-ray top view of FIG. **12** showing the rollers over the pulleys.

FIG. **14** is an x-ray isometric view of one of the rollers in FIG. **13**.

FIG. **15** illustrates an x-ray top view of FIG. **12** showing a swiveling pulley with a rub block instead of the rollers over the pulleys shown in FIGS. **12** and **13**.

FIG. **16** illustrates an x-ray top view of FIG. **12** showing a swiveling pair of pulleys instead of the rollers over the pulleys shown in FIGS. **12** and **13**.

FIG. **17** shows a modification of the embodiment of FIG. **16** with a dial to indicate the angle left or right that the cable is pulled from the equipment.

FIG. **18** shows the swiveling pair of pulleys of FIG. **16** with a dial to indicate the angle up or down that the cable is pulled from the equipment.

FIG. **19** is another x-ray top isometric view of the exercise equipment constructed in accordance with the present invention.

FIG. **20** is an x-ray side view of a multipurpose chair or bench that is an optional feature of the equipment shown attached to the exercise equipment of the invention.

FIG. **21** is an x-ray top view of the multipurpose chair or bench shown in FIG. **20**.

FIG. **22** is an x-ray front view of the multipurpose chair or bench shown in FIG. **20**.

FIG. **23** is a top isometric view of the multipurpose chair or bench shown in FIG. **20**.

FIG. **24** is a bottom isometric view of the multipurpose chair or bench shown in FIG. **20**.

FIG. **25** illustrates two units of the equipment of the invention joined together with an adjustable and repositionable bench positioned between them. There is also a series of small hooks or posts **111** that serve as a built-in rack for holding different attachments, handles, bars and grips.

FIG. **26** is a front view of an economy model of the invention, which has a single cable.

FIG. **27** is a top view of the economy model depicted in FIG. **26**.

FIG. **28** is a left isometric view of the model of FIG. **26**.

FIG. **29** is an enlarged view of a different version of the trolley shown in FIGS. **26**, **27**, **28**, **30**, **30**.**1** and **31**.

FIG. **30** is a right side view of the model of FIG. **26**

FIG. **30**.**1** is an enlarged view of the model of FIG. **30**

FIG. **31** is a right isometric view of the model of FIG. **26**.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. **1**–**19** illustrate a first preferred deluxe embodiment of the invention.

FIGS. **20**–**25** illustrate an optional chair or bench that may be used with the units of equipment of the invention.

FIGS. **26**–**31** illustrate a simpler, economy embodiment of the invention.

In FIGS. **1** to **31**, the same or similar parts are identified by the same reference number.

FIG. **1** is an x-ray side top isometric view of one embodiment of exercise equipment **10** constructed in accordance with the present invention. There are seven pairs of pulleys, one pair of which is identified as **11**, placed in the arcuate slot formed by the two side frames **12** and each pair is spaced 30° away from its neighbor(s), as may be better seen in FIG. **2**. A greater or smaller number of pairs of pulleys could be used. The resistance, a weight stack **13** is comprised of a number of small weights that can be used in combination. In order to further simplify and thereby clarify the description in FIGS. **1**–**2**, **5**–**15** and FIG. **19**, cables **9** have generally been omitted as well as their paths through the series of rollers **15**, pairs of pulleys **11** and multiple pulleys **14**.**1** and **14**.**2**. The proximal end of each of the cables **9**, outside rollers **15**, is attached to a means that enables a user to exert force against the resistance. The distal ends of the cables **9** are threaded between rollers **15** and pulleys **11** and then through a series of pulleys identified as **14**.**1** and **14**.**2**.

FIG. **2** is a simplified x-ray side view of the exercise equipment **10** in FIG. **1**. The parts illustrated have been identified in the description of FIG. **1**. FIG. **2** shows markings on the side frame **12** of the equipment that indicate the position of the pulleys on the arc of the equipment.

FIG. **3** is a more detailed x-ray side view of the exercise equipment **10** in FIG. **2**. The proximal end of each of the cables **9**, outside rollers **15**, is attached to a means that enables a user to exert force against the resistance. Examples of those means are a bar **100**, a loop handle **102** and a cuff **103**, all of which have a fastener **101**.**1** that enables them to be attached to fastening point **101** at the proximal ends of cables **9**. For example, the bar **100**, loop handle **102** and cuff **103** may be mixed or matched at the proximal ends of cables **9**. Seven cables **9** are strung from the proximal end external to the equipment **10** through pairs of pulleys **11** from which they exit in generally horizontal position to the right where they pass over redirection pulleys **14** to change direction to vertically upward. The pulleys **14** serve to redirect the cables **9** from a generally horizontal incoming direction to vertical upward direction. The remainder of the parts depicted in FIG. **3**, with the exception of Pulleys **14**.**1**, are described in the description of FIGS. **1**, **4**, **8**, **10** and **11**. Pulleys **14**.**1**, of which there are seven aligned vertically all of which are identified, serve to redirect the distal ends of the cables **9** from a generally vertical upward direction to a substantially horizontal direction to seven aligned pulleys **14**.**2** (only two of which are shown) and serve to redirect cables **9** to a substantially vertical downward direction. The distal ends of the cables **9** after pulleys **14** are shown in FIG. **4**.

FIG. **4** is an x-ray front view of a portion of the exercise equipment in FIG. **1**. FIG. **4** illustrates in more detail how one cable **9**.**1** is strung through the equipment **10**. The cables **9** are horizontally redirected when they pass over pulleys **14**.**1** and then vertically downward as they pass over pulleys **14**.**2** where the distal ends of cables **9** are attached to counterweights **16**. When the proximal end of a cable **9** is pulled, it raises the counterweights **16**. A horizontal plate **18** with holes, slots or other openings cut so the cables **9** pass through the plate **18** is positioned above the counterweights **16** and extended over and attached or welded to a vertically positioned guiding means, e,g., a linear bearing **18**.**1** (or other guiding mechanism such as a roller system, or a bushing housed in a tube traveling on a rod, bar or other vertical support) traveling along a vertical shaft **20** positioned between the weight stack **13** and the counterweights **16**. Single cable **9**.**1**, which is attached to the underside of horizontal plate **18** and to a pulley **14.3** below, then routed upward to two pulleys **14.4** above the weight stack and down to a plate **13.1** to guide the weights **13** vertically along two upright guide rods **22** extending downward through the weight stack **13** and a rod **23** extending downward through the center of the weight stack with holes **24** cut in it to allow a selector pin **25** to slide into the weight stack **13** so the user can select the desired weight to lift. When the user pulls on the cable **9** end at the point of egress, the counterweight **16** is lifted, thereby lifting the horizontal plate assembly **18** and the selected weight **13**. Other cables **9** in the system that are not engaged by the user at that time are held in the ready position by their respective counterweights **16**.

As may be seen in other FIGS., ultimately, the distal ends of the cables **9** are attached to a counterweight **16**, which travels vertically through a slot mounted in a housing with each slot and counterweight **16** positioned side by side at the end of each respective cable **9**, (one counterweight **16** for each cable **9** threaded through the system) positioned next to the resistance, which in this case is a set of weights **13**, and housed within a vertical set of guide tracks **17** (see FIGS. **5**, **6** and **10**). They are positioned within the housing on the far side of the weights, but could be positioned in other arrangements relative to the resistance. Optimal positioning is next to or adjacent to the resistance. The counterweights **16** are optimally also positioned at or slightly beneath the top plane of the weight stack **13**, but could be positioned above the top plate.

FIG. **5** is a partial isometric view of the top of the equipment **10**.

FIG. **6** is a partial isometric backside view of the bottom of the equipment **10**.

FIG. **7** is an enlarged view of part of FIG. **6**.

FIG. **8** shows a variation of FIG. **4**. Another method of lifting the weight stack is to have the horizontal plate **19** (see FIG. **9**) attached to the linear bearing **18.1** extended to reach out over the weight stack **13** and fastened or welded to a set of guide tubes **21** to guide the weights **13** vertically along two upright guide rods **22** extending downward through the weight stack **13** and a rod **23** extending downward through the center of the weight stack with holes **24** cut in it to allow a selector pin **25** to slide into the weight stack **13** so the user can select the desired weight to lift. When the user pulls on the proximal end of cable **9** at the point of egress, the counterweight **16** is lifted, thereby lifting the horizontal plate assembly **19** and the selected weight **13**. Other cables **9** in the system that are not engaged by the user at that time are held in the ready position by their respective counterweights **16**.

FIG. **9** illustrates a variation of the bottom of the equipment **10** shown in FIG. **6**.

FIG. **10** is an x-ray top isometric view of the exercise equipment **10** constructed in accordance with the present invention. The parts illustrated in this FIG. have been described in connection with the previous FIGS.

FIG. **11** is an x-ray top view of the exercise equipment **10**. The parts depicted have been described in connection with the previous FIGS.

FIG. **12** is an x-ray side view of one pair of pulleys **11** and roller **15** that is rotatably set in bracket **116**, which in turn is set in the curved track **12**. The other parts depicted have been described in connection with the previous FIGS.

FIG. **13** is an x-ray top view of FIG. **12** showing the rollers **15** over the pulleys **11**. The parts depicted have been described in connection with the previous FIGS.

FIG. **14** is an x-ray isometric view of one of the rollers **15** that is shown in FIG. **13**. The parts depicted have been described in connection with the previous FIGS.

A system of rollers **15** over the pulleys **11** is shown in FIGS. **12**–**14** arrangement allows the cable **9** to be pulled from the equipment **10** and routed in any direction (limited only by the equipment body itself) for infinitely positionable resistance training with ease and fluidity while optimizing the intended design of the pulleys **11** themselves which is to have the cable travel along their center axis.

FIGS. **15**–**18** show a swiveling (vertically approximately 150°) pulley or pulleys **30** in mounting bracket **31**.

FIG. **15** illustrates an x-ray top view of FIG. **12** showing a swiveling pulley **30** with a rub block **30.1** set in swiveling bracket **31** instead of the rollers **15** over the pulleys **11** shown in FIGS. **12** and **13**.

FIG. **16** illustrates an x-ray top view of FIG. **12** showing a swiveling pair of pulleys **30** instead of the rollers **15** over the pulleys **11** shown in FIGS. **12** and **13**.

FIG. **17** shows a modification of the embodiment of FIG. **16** with a dial **31.1** to indicate the angle left or right that the cable **9** is pulled from the equipment **10**.

FIGS. **16**–**18** show a the swiveling pair of pulleys **30** with a dial **31.2** to indicate the angle up or down that the cable is pulled from the equipment and indicator **31.3** to indicate the egress point along the arced track the cable **9** is being pulled from. This pair of pulleys, which is intended to replace the rollers **15**, are mounted on, and can swivel about, pivot point **31.4**, and can thus follow the cable as it exits the machine. The other parts depicted have been described in connection with the previous FIGS. This arrangement allows for the use of a unique vector marking, reading and monitoring system (VMRMS) which is inherent in this invention. To get an accurate reading one needs a compass or numeric marker system placed at or near the three points of pulley **11** orientation. It needs to allow the user the ability to record all three vector ranges of movement the cable **9** traveled through while performing the workout. This is comprised of four steps: 1) Select the attachment; 2) Orient one's self and the desired body part one wishes to train relative to the proper egress point; 3) Pull the cable **9** through the desired motion path; and 4) Look at the reading markers and record the point along the arc from which one pulled; namely the horizontal vector range the cable passed through and the vertical vector range. This marking system and recording method can be applied to many of the three-dimensional pulley/cable training systems now on the market which use an extended arm method that rotates a swiveling pulley mounted at the egress end and pivots the other end on a point attached midway up the housing of the resistance. The unique vector marking/reading and analysis system of the invention can also be applied to these devices as well by placing them at the three points of axis. Yet, the design of the invention further optimizes the use of the vector monitoring reading measuring system (VMRMS) and makes its use more practical and easier so that the curved track itself, whether on the multiple fixed point systems or the movable trolley systems, acts as a compass itself. Therefore when the desired egress point is selected all three markings from which to obtain the reading are immediately disposed next to each other. This is advantageous in that the user can see all three readings simultaneously during the movement of the exercise, making tracking, recording and monitoring easier. This system lends itself to even further advancements by the addition of sensors to the pair of pulleys **11** and cable **9** that record and display the speed and directional readings.

FIG. **19** is another x-ray top isometric view of the exercise equipment **10** constructed in accordance with the present invention, wherein the parts have previously been described.

FIGS. **20** to **24** illustrate one example of optional ancillary equipment that may be used with the exercise equipment **10** of the invention.

FIG. **20** is an x-ray side view of a chair or bench **40** that is an optional feature of the equipment **10** shown attached to the exercise equipment **10** of the invention. Chair or bench **40** is shown with cushion **41** in the upright or chair position. When cushion **41** is positioned horizontally over cushion **42**, it forms a bench with seat cushion **43**. The cushion **41** may be adjusted horizontally by moving cushion **41** back and forth and securing it in the desired position by inserting a pin **45.1** in an adjusting hole in member **45** and horizontal adjustment bar **48** (as shown in FIG. **22**). The angle of cushion **41** may be changed by pulling pin **44.1** from adjustment means **49** and moving side support members **44** (pivoting about bolts passing through **44** and extensions **50** and pillow blocks **51** attached to member **45**) relative to adjustment means **49** and then inserting a pin **44.1** in the appropriate holes in parts **44** and **49** (as shown in FIG. **22**). All of parts **41** to **46** and **48** to **51** are directly or remotely attached to its frame members **47**. As is best illustrated in FIG. **23**, the leg extension pads **46** are pivoted centrally in front of the seat cushion **43**.

FIG. **21** is an x-ray top view of the chair or bench **40** shown in FIG. **20**.

FIG. **22** is an x-ray front view of the chair or bench **40** shown in FIG. **20** showing how cushion **41** and support members **44** pivot about a set of posts **50** attached to a set of pillow blocks **51** attached to cover plates **45** riding on horizontal adjustment bars **48** mounted on both sides of frame **47**, not shown in other FIGS. It also shows how cushion **41** can be adjusted along a horizontal path forward and backward along adjustment bars **48**.

FIG. **23** is a top isometric view of the chair or bench **40** shown in FIG. **20**.

FIG. **24** is a bottom isometric view of the chair or bench **40** shown in FIG. **20**.

FIG. **25** illustrates two units of the equipment **10** of the invention joined together through intermediate connectors **110** with bench **40** positioned between the units, and posts or hooks **111** which are used as a rack for holding handles, grips, bars and other attachments. These units, which are placed side by side, can be arranged at any selected relative angle.

Movable trolley equipment **60** is shown in FIGS. **26** to **31**. FIGS. **26** and **27** show only selected parts of equipment **60**

FIG. **26** is a front view of an economy model **60** of the invention, which has a single cable **68**. The movable trolley equipment **60** has a curved track **64**. Single cable **68** is connected to a resistance means **69** (depicted here as a weight stack, but could be another form of resistance) and then routed by a series of pulleys, collectively indicated as **70**. The movable trolley system **63** of the invention preferably has a one-step system for repositioning the housing **61** and taking up the cable slack by simultaneously activating cable take up means **72**. There is a one-step release mechanism/lever **74**. The proximal end of cable **68** is connected to the attachment **76** (shown as a handle, but could be any number of different attachments as shown in FIG. **3**).

FIG. **27** is a top view of the economy model **60** depicted in FIG. **26**. There is a one-step release mechanism/lever **74**, brake cable **75** and movable trolley system **63**.

To actuate the one step system shown in FIGS. **26–31**, lever **74** is pulled inward (to the left) causing it to rotate on pivot connection **74.3** acting as a fulcrum. The end of **74** is attached to pin **74.1** and to the end of a flexible sheathed cable **75**. When lever **74** is pulled inward it pulls the pin **74.1** out of positioning hole **74.2** on housing **61** and out of positioning hole **64.2** located on curved flat bar **64.1** within the housing **61** traveling along curved flat bar **64.1** and curved round bar **64**, thus freeing it up for repositioning movable trolley system **63** and egress point **67** along the curved track. Simultaneously, brake cable **75** is pulled outward from housing **61** (shown in FIG. **28**) causing the pin in brake **73** to retract from corresponding repositioning holes along vertical bar **73.1** (shown in FIG. **30**). Slack in cable **68** is caused when movable trolley system **63** is repositioned along the curved track. Thus, cable take-up mechanism **72**, acting as a counterweight (instead of a counterweight, a spring, elastic cord, electronic take-up means or a winch may be used) comprised of a pulley **72.1** (shown in FIG. **28**) wherein cable **68** is routed through pulley system **70** to the under side of pulley **72.1** then to the resistance means **69** shown here as a weight stack, moves vertically up or down to take out the slack in the cable **68**. Pulley **72.1** is mounted on a hollow housing **72.2** with bushings or rollers within (bushings or rollers not shown) (or can be a pulley mounted on a movable housing that can travel in a substantially vertical direction on any number of various track, rods, tubes, shafts or bars) and set to travel along vertical bar **73.1** set within the housing **72.2**. The cable take-up mechanism **72** travels in a substantially vertical direction up or down in direct proportion to the distance the movable trolley system **63** is moved along the arced curve. Once the new position is found for the moveable trolley system **63** the lever **74** is pushed outward causing pin **74.1** and brake pin **73** to simultaneously slide into their corresponding holes locking them in place along curved rod **64**, curved flat bar **64.1** into holes **64.2** and holes in vertical rod **73.1** respectively.

The brake **73** and cable take-up means **72** as well as the moveable trolley system **63** can be applied in both a fixed end and a closed loop cable system. Brake **73** can also be used when the cable take-up means **72** is between the egress point **67** and the resistance means **69**, or past the end of the resistance means **69** as shown in U.S. Pat. No. 5,102,122.

FIG. **28** is a left isometric view of the model **60** of FIG. **26**. The movable trolley equipment **60** allows for one step to reposition a movable trolley system **63** comprised of a housing **61** shown here to contain a pair of bushings **61.1** fixed within it (yet could be made of a housing with rollers, bearings or other gliding means) and a one-step release/lever **74** and a brake mechanism comprised of parts **74.1–74.3** (shown in FIG. **27**) to reposition the movable trolley system **63**. The housing **61** can be positioned along a curved track shown here as curved rod **64** and curved flat bar **64.1** running parallel to each other and having an equally spaced slot between them (yet could be made of other combinations of rods, bars, tubes or tracks having housing with rollers, bearings or other gliding means traveling upon them or a solid track with a movable trolley affixed). This allows the use of a sturdy, less expensive frame **65** and a curved track for the movable trolley system **63** to move along to relocate an egress point **67** for the proximal end of a cable **68** the distal end of which is connected to a resistance means **69** (depicted here as a weight stack, but could be another form of resistance) and then routed by a series of pulleys, collectively indicated as **70**, through a cable take-up means **72** to two parallel pulleys **62** located on the movable trolley system **63**. The user can weight train with both light and heavy resistances in infinitely variable resistance planes.

The movable trolley equipment **60** of the invention preferably has a one-step system for repositioning the movable trolley system **63** and taking up the slack in cable **68** by simultaneously activating cable take up means **72**. Such a one-step system has a mechanically or electronically actuated brake **73** (shown in FIG. **30**) using levers, cables, pins, pads, or other braking means that is activated when the one-step release mechanism **74** shown as a lever but could be a knob, handle, push- button or other actuating means for repositioning the movable trolley system **63** is used. When the mechanism comprised of **74**–**74**.**3** and brake cable **75** to unlock housing **61** is activated, the brake **73** at the distal end of brake cable **75** is simultaneously released on the cable take-up means **72** which acts as a counterweight. Instead of a counterweight, a spring, elastic cord, electronic take-up means or a winch may be used. When the movable trolley system **63** is repositioned and locked in place along curved track and affixed in place by one of the positioning holes **64**.**2**, the brake **73** is simultaneously locked onto the vertical bar **73**.**1** by its corresponding positioning hole. The brake cable **75** and one-step cable take-up mechanism **72** are oriented in such a way that when the housing **61** is moved along the curved track, the length of the cable **68** remains constant with regards to the egress point **67** and the proximal end of cable **68** that connects to the attachment **76** (shown as a handle). When the housing **61** is unlocked, the brake**73** (as seen in FIG. **30**) is simultaneously unlocked, allowing the cable slack to be taken up by cable take-up mechanism **72**.

FIG. **29** is an enlarged view of an alternative design of the movable trolley system **63** shown in FIG. **28**. It illustrates a non-pivoting housing **77** containing pulleys **62** attached by extensions **78** to movable housing **61** and one-step release mechanism/lever **74**. Cable **68** passes through slots in the narrow ends of housing **77** and through pulleys **62** as the housing **61** is repositioned along track **64**. This non- pivoting housing enables the attachment of pulleys (or pulley) **30** in mounting bracket **31** as depicted in FIG. **16** or pulley **30** and rub block **30**.**1** in mounting bracket **31** as depicted in FIG. **15** or rollers **15** as depicted in FIG. **13** to be mounted over pulleys **62**.

FIG. **30** is a right side view of the model **60** of FIG. **26**. It shows a connecting metal brace **65**.**1** attached to vertical bar **65** and curved flat bar **64**.**1**. The metal brace **65**.**1** serves to keep the curved track in line when resistance is applied during use of the exercise equipment **10**.

FIG. **30**.**1** is an enlarged view of part of the model **60** of FIG. **30**. It shows pulleys **62** mounted to a bar **62**.**1** attached to a pivoting point **62**.**2** attached to the end of support bracket **61**.**2** which, in turn, is attached to housing **61**. Cable **68** can pass between pulleys **62** thus allowing the user to be able to pull on attachment **76** in any direction as the pulleys pivot about point **62**.**2**, limited only by the body of the frame **60**.

FIG. **31** is a right isometric view of the model **60** of FIG. **26**.

The movable trolley system of the invention is more conventional in its fabrication, preferably using welded square tubing as its frame and exposing more of the inner workings of the equipment as do many cable-cross units of equipment currently on the market which are made with sturdy enough materials and careful design as to minimize the risk of snapping cables and pinching extremities. However, its overall design is unique due to the use of the curved track (made up in this version of a curved round bar **64** and a curved flat bar **64**.**1** but could be made of other combinations and forms of curved rods, bars cylinders or tubes) and the one-step cable take up system **72** and the movable trolley system **63**. Its safety is increased. The movable trolley system of the invention provides most, if not all of the benefits of the fixed egress system of the first preferred embodiment of this invention.

Other devices that use repositionable pulley egress points use pulleys located within swiveling housings wherein the housing swivels around a vertical bar or at the end of an extended moveable arm. Such swiveling systems can be used fairly well on a curved system a shown in FIGS. **26**–**28** and **30**–**31**. A better method is to use a single pulley or a set of fixed double pulleys which can be fixed in a side wall as shown in the multiple egress system of the invention or a set of fixed double pulleys which can be fixed in a housing which runs parallel to the curve and is mounted on a trolley (as seen in FIG. **29**). Such fixed systems can then use the pulley (or pulleys) **30** in mounting bracket **31** swiveling left or right approximately 150° as depicted in FIG. **16** or rollers **15** in FIG. **13** over the pulleys **11**. This arrangement allows the cable to be pulled from the equipment and routed in any direction (limited only by the equipment body itself) for infinitely positionable resistance training with ease and fluidity while optimizing the intended design of the pulleys themselves, which is to have the cable travel along their center axis. This arrangement also allows for the use of a unique vector marking, reading and monitoring system (VMRMS), which is inherent in what is claimed in this invention.

Both retain the biomechanical advantages of the curve and pulley/cable resistance delivery system providing resistance in three-dimensional space, are aesthetically pleasing and unique in product styling, offer ease of use and understanding, offer wheelchair accessibility, have the ability to preset or easily reset the attachments and the sequence of various exercises and provide a minimum number of adjustment steps, provide an infinite number of training possibilities, provide faster and safer workouts, are intuitively understood, provide economies of scale for manufacturing, have a means to record and monitor exercises in three-dimensional space, provide a 360 degree workout environment and can service a wider range of users Units of equipment known to be in existence today cannot offer all these benefits.

The new moveable trolley system **63** with its one step repositioning system comprised of release mechanism/lever **74** and cable take-up mechanism **72** and brake system **73** takes what otherwise would be a six step process when using the moveable trolley system as is the case with ELGIN and the equipment described in U.S. Pat. No. 5,102,111 (up to twelve in the dual equipment configuration) and breaks it down to one or two steps. The only thing necessary to change often is the means for changing the amount of resistance the user wants. Everything else is made simple.

The Total Body equipment of the invention optimizes both form and function and provides the ability to create diverse product lines utilizing the core concept and virtually identical parts, whereby manufacture of entire new lines of products is made possible by simple combinations of egress points. They also can work in conjunction with specially designed benches, a multi-positionable/multi-functional chair with interchangeable parts and various grips, bars and attachments to create an easily expanded use of the new line of products. This line can be further diversified to meet the needs of specific user groups by reconfiguring and customizing the resistance means with differing iterations of progressive weight resistance. There is no line available today that allows the manufacture of so many resistance units of equipment to be fabricated from the same standard parts allowing for the need for less custom parts, greater efficiencies in production, ease of assembly, ease of shipping and all areas associated with the product's manufacture, yet still delivers many more benefits to the user as compared to resistance training units of equipment currently available.

The units of equipment in the line can be made from standard metal tubing, cables or straps, pulleys and one or more resistance means. They can also be fabricated from parts made out of sheet metal or sheet plastic in conjunction with standard cables or straps, pulleys and resistance means available to create a line of similar characteristics yet having a totally new look and product styling. Such fabrication using almost 100% laser cut sheet material in the frame and housings is unique in that it requires few welded parts, unlike any device currently available, which provide both light and heavy loads of resistance. Standard sets of parts are preprogrammed into the laser, cut as needed, then easily mixed and matched to create an easy to assemble and wide variety of different units of equipment that comprise an easily expandable line.

This unique core design in this field allows for greater ease of manufacture and use of fewer parts yielding the ability to fabricate two or more product series with four or more different product lines in each, with a dozen or more products in each line. Units of equipment made with the movable trolley system or the multiple fixed point system offer many unique advantages over units of equipment currently available. Particularly providing the user the ability to train for muscular development in three dimensional space in such ways that more closely relate to real human movement patters found in real life functions such as playing sports, carrying groceries, getting up and down out of chairs, performing lifting tasks at work, etc. It also allows for those in physical rehabilitation to more easily reach muscle groups that need work, can provide both light and heavier resistance loads which are now measurable and consistent throughout the movement and able to be repeated in three dimensional space. Up until now therapists relied on fixed point, low weight pulley systems or ones that travel along a straight line vertically positioned along side the user; and rubber band and rubber straps fixed to door knobs and wall rods and the like.

Units of equipment with multiple fixed egress points offer another type of improvement over units of equipment currently available. This design eliminates the need for a cable take-up locking mechanism and the added steps of having to unlock then relock the connecting means users have to perform each time when moving to a different point of egress. Similarly, the fixed egress point design is unique in that it eliminates the step of having to constantly reposition the egress point and lock it in place, thereby eliminating another step for the user. It further eliminates steps for the user by allowing a multiple combination of grips, handles and bars to be attached ahead of time, so changing exercises is faster, more efficient and easier. By the addition of two roller **15** arms running parallel to the egress pulleys **11** or **62** and/or the widening of the flange along the point of egress on the egress pulleys **11** or **62**, or by adding a swiveling pulley **30** in front of two egress pulleys **11** or **62** to the area where as the cable **9** or **68** is pulled by the user, it creates a wide vector of training for the user. The user can now pull the cable **9** or **68** from the equipment freely in any direction without it rubbing or getting caught up.

Other units of equipment that attempt to orient a cable's egress point in various places around a user use one or two extension arms and one or two dual pulleys setups that mount on a swiveling housing attached to the end of the arms. Such devices are unsteady and cannot readily support heavier resistance training regimens. They are also difficult for the user to readily understand where to position the egress point for optimal training and are not readily suited for ease of recording the position in three-dimensional space the user trained in. Adding a swiveling pulley **30** or dual pulleys in front of two egress pulleys **11** or **62** to the area where as the cable is pulled by the user that creates an even more unique feature for the system. This third pulley **30** or dual pulleys mounted in front of the two fixed pulleys **11** or **62** allows for compass recorders to be easily affixed at the point of all three ranges of egress thereby allowing the user a simple and effective means to record training data and progress. It also makes it easy to return to the unit and repeat the exact training movement and measure the movement in three-dimensional space.

The unique product styling of all the units of equipment in these lines also sets them apart from other devices currently available. Their new look creates a feel of the user having his/her own space in which to train. They are also intuitive as to how any products in the line are to be used, unlike many other lines today that require instruction. Some of their features and advantages are:

1) Provide a means to position one or more repositionable egress trolleys or two or more fixed egress means positioned along a variety of single or dual walls, or single or dual tracks, rails, tubes or cylinders or other support means of a variety of shapes other than just a straight line (yet could include a straight line) relative to a user pulling on a handle connected to a connecting means connected to one or more resistance means and having one or more cable take-up means.

2) Egress point or points having one or two pulleys, which provide a way for the connector, means (cable or strap or other) to move in any direction once pulled away from the point where the pulley is affixed. This can be accomplished by having one of the pulleys in a three pulley assembly on a swiveling arm; or by widening the flange on the outer edge of the egress pulley/pulleys; or by having it fixed with rollers positioned along side the pulley or pulleys running in a parallel plain with the pulley or pulleys at the point at or near the point of egress of the cable, strap or other as it leaves the pulley. These rollers can be of any smooth, hard material such as plastic or metal and can be straight, convex or concave cylinders.

3) In the case where a single sidewall or track, rail, shaped tube or cylinder or other support means is used, cables or other connector means such as straps, chains or other may become exposed which can be dangerous to the user. A cover plate may be necessary in this case to cover the exposed connector means. Another way to hide exposed cable is to rout it through the inside of hollow tubing or cylinders with directional pulleys.

4) The take-up means for the connector means can be a variety of means including but not limited to counter weights, springs, retracting devices, brake systems. Such take up means can be positioned anywhere along the path of the connector means or at either end.

5) A standard configuration or set of configurations, which form the basis of a series or line of products, that takes that standard configuration and breaks it into different units of equipment exercising different body parts yet employing all the benefits of the movable trolley sys-

tem and/or the multiple-fixed point egress system using a variety of shapes other than a straight line (yet could include a straight line). Each equipment in the line being capable of accepting a variety of attachments, benches, chairs, etc. that creates greater specificity and more versatility for the user.

6) Each equipment in the line being able to accept differing resistance means configurations and customized iterations of varying resistance thereby adapting the line for specific user groups in an easy, economical way.

7) Each equipment having a built in rack for holding different attachments, handles, bars and grips.

8) The units of equipment being configured in such a way as to allow the smallest possible footprint yet providing a workout area capable of servicing the training or rehabilitation needs of a wide variety of users in an ergonomically efficient way. They are also wheelchair accessible.

9) The units of equipment being designed in such a way as to allow the creation of space efficient room layouts offering new and dynamic looks to a facility yet conserving floor space.

10) A line of units of equipment that can be developed from one single standard set of parts that can be transformed into other series simply by repainting, redecaling, changing the resistance means and the attachments. A design that allows for the creation of Total Body units of equipment which use a standard set of parts which can be used to create a whole line of exercise units of equipment utilizing various combinations and mixes of egress points along one or two of the various shaped paths as they are positioned relative to the user in unilateral and bilateral formations which themselves can be fixed or move relative to themselves to create varying points of egress for the user to grab onto attachments connected to the connector means creating a line which enables the user to train specific body parts in three dimensional planes in ways that more closely resemble human movement patterns in real life situations.

11) The Total Body units optimize both form and function and provide the ability to create diverse products utilizing the core concept and virtually identical parts whereby manufacture of an entire new line of products is made possible by simple combinations of egress points.

12) A line of units of equipment that is intuitive to use.

13) A line of units of equipment that creates a feeling for the user of having his/her own space in which to workout in.

14) A line of units of equipment that creates a new look and product styling.

15) A line of advanced pulley system units of equipment which offer the user freedom of movement and the benefits similar to that of lifting free weights such as using the stabilizer muscles as well as the prime movers during an exercise yet is more advantageous in that the user is not restrained by resisting the force imposed by gravity only in the vertical vector, but allows the user the freedom to pull against force vectors in virtually any plane and at virtually any angle without having to drastically reposition one's body relative to the egress point. Such units of equipment are considered biomechanically optimized. Bilateral units provide bilateral workouts which stabilize the body and fix the points at which the user generates the force to move the weight, thereby providing a more focused, accurate and measurable movement. Cable units of equipment also allow for the optimum provision of resistance throughout the full range on normally varying carrying angles the body moves through when performing a natural motion and can match up perfectly with the varying strength curves created as a resistance is pulled though varying planes relative to the point of origin. Those that provide egress points fixed along an arced path more closely relate to the rotational patterns found in human movement.

16) A line of units of equipment using a third pulley mounted in front of the two fixed pulleys which allows for compass recorders to be easily affixed at the point of all three ranges of egress thereby allowing the user a simple and effective means to record training data and progress.

17) A line of units of equipment, which makes it easy to return to the unit and repeat the exact training movement used previously and measure the movement in three-dimensional space.

18) A line of units of equipment that are considered resistance training systems rather than just units of equipment due to fact that more can be done for more user groups in measurable, systematic ways using less units of equipment.

The foregoing specification and drawings have thus described and illustrated a novel improved exercise system that fulfills all of the objects and advantages sought therefore. Many changes, modifications, variations and other uses and applications of the subject invention will, however, become apparent to those skilled in the art after considering this specification which discloses the preferred embodiments thereof. All such changes, modifications, variations and other uses and applications which do not depart from the spirit and scope of the invention are deemed to be covered by the invention, which is to be limited only by the claims which follow.

What is claimed is:

1. Exercise equipment including a housing having a structural surface defining a prescribed concave arcuate contour, at least three cable exit points positioned along the structural surface, each exit point having passed therethrough a cable having a proximal end and a distal end, the proximal end of each cable being located outside the structural surface and being attached to a device that enables a user to exert a tensile force to the cable by pulling the cable in any desired direction, the distal end of each cable being coupled to a common source of resistance within the housing such that when the proximal end of each cable is pulled by a user, the resistance exerts a counterforce to such cable and the distal end of each cable coupled to a counter-resistance.

2. Exercise equipment as claimed in claim **1**, wherein the source of resistance is variable.

3. Exercise equipment as claimed in claim **1**, wherein said counter-resistance restore the cables to their original positions after being pulled by a user.

4. An exercise equipment as claimed in claim **3**, wherein a the distal end of each cable is attached to a respective counter-resistance positioned next to the source of resistance, but before being attached to the counter-resistances the cables pass through or by a substantially horizontal plate which is positioned above the counter-resistances and attached to a substantially vertically positioned guiding means traveling along a substantially vertical path next to the source of resistance, a single cable being attached to the underside of the substantially horizontal plate and directed downward to and over a third pulley below, redirected by fourth pulleys to the source of resistance, so that when the user selects a particular resistance to lift at a particular egress point, the user pulls the proximal end of a particular cable external to the exercise equipment, the counter-resistance at the distal end of this cable lifts the substantially horizontal plate which, in turn, pulls on the single cable below which lifts the source of resistance, while other cables in the equipment which are not engaged by the user at that time are held in place by their respective counter-resistances.

5. Exercise equipment as claimed in claim **3**, wherein the counter-resistances include means for distributing the source of resistance between any or all of the cables to which a tensile force is applied by a user.

6. Exercise equipment as claimed in claim **1**, wherein the source of resistance includes a set of weights which are lifted when said proximal end of each cable is pulled by a user.

7. Exercise equipment as claimed in claim **6**, wherein said counter-resistance comprise at least one counterweight which retains the cables in a retracted position when they are not being pulled by a user.

8. Exercise equipment as claimed in claim **7**, wherein each cable, from its proximal end to its distal end, passes through the exit point and then passes through a series of pulleys, the distal end of each cable being attached to a counterweight housed within a vertical set of guide tracks; a horizontal plate with openings therein for passage of the cables therethrough, the plate being positioned above the counterweights and extending over and attached to a vertically positioned guide means traveling along a vertical shaft positioned between the set of weights and the counterweights, the plate being extended to reach out over the set of weights and being fastened to a set of guide tubes which guide the set of weights vertically along two upright guide rods extending downward through the set of weights; and a rod extending downward through a center of the set of weights with holes cut in it to allow a selector pin to slide into the set of weights so the user can select the desired weight to lift so that when the user pulls on the cable proximal end at a point of egress, the counterweight is lifted thereby lifting the horizontal plate assembly and a selected weight, other cables in the system not engaged by a user at that time being held in the ready position by their respective counterweights.

9. Exercise equipment as claimed in claim **8**, wherein there is a second exercise equipment as recited in claim **8** positioned adjacent a first exercise equipment as recited in claim **8**, said first and second exercise equipment being capable of being used simultaneously by a single user exercising two limbs or other parts of his body simultaneously or by two users simultaneously.

10. Exercise equipment as claimed in claim **9**, wherein the first and second exercise equipment are placed side-by-side at a selected relative angle.

11. Exercise equipment as claimed in claim **9**, wherein the first and second exercise equipment are integrated into a unitary construction.

12. Exercise equipment as claimed in claim **9**, further comprising a chair or bench positioned adjacent the exercise equipment to enable a user to exert a tensile force to a cable while sitting or lying down.

13. Exercise equipment as claimed in claim **6**, wherein the set of weights are lifted when said proximal ends of a plurality of said cables are pulled by a user.

14. Exercise equipment as claimed in claim **1**, wherein the device that enables the user to exert a tensile force to a cable is selected from the group consisting of a handle, strap, belt, rope, bar and leg curl.

15. Exercise equipment as claimed in claim **14**, further comprising racks for holding handles, grips, bars and other attachments.

16. Exercise equipment as calaimed in claim **1**, wherein there is a second exercise equipment as recited in claim **1** positioned adjacent a first exercise equipment as recited in claim **1**, said first and second exercise equipment being capable of being used simultaneously by a single user exercising two limbs or other parts of his body simultaneously or by two users simultaneously.

17. Exercise equipment as claimed in claim **16**, wherein the first and second exercise equipment are placed side-by-side at a selected relative angle.

18. Exercise equipment as claimed in claim **16**, wherein the first and second exercise equipment are integrated into a unitary construction.

19. Exercise equipment as claimed in claim **1**, further comprising a chair or bench positioned adjacent the exercise equipment to enable a user to exert a tensile force to a cable while sitting or lying down.

20. Exercise equipment as claimed in claim **1**, further comprising at least one rub block at the exit point of said cables.

21. Exercise equipment as claimed in claim **1**, wherein the cable length between the proximal end of each cable and its associated exit point through which it passes is substantially equal, when no tensile force is applied thereto by a user.

22. Exercise equipment as claimed in claim **1**, wherein a pair of pulleys are disposed at at least one cable exit point.

23. Exercise equipment as claimed in claim **22**, further comprising a pair of rollers at said at least one exit point of said cables, said rollers having roller axes which are substantially parallel and substantially perpendicular to axes of said pulleys.

24. Exercise equipment as claimed in claim **22**, further comprising a second pair of pulleys at said at least one exit point of said cables, said second pair of pulleys having pulley axes which are substantially parallel and substantially perpendicular to axes of said first pair of pulleys.

25. Exercise equipment including a frame having a track extending along a prescribed arcuate path; a movable trolley having an exit point for a cable, said trolley being repositionable to fixed positions along the track; a said cable extending through said exit point and having a proximal end, located outside the track and attached to a device that enables a user to exert a tensile force to the cable, and a distal end coupled to a source of resistance within the frame; means for maintaining a length of the cable between its proximal end and the exit point through which it passes substantially constant, independently of the position of the trolley along the track, when no tensile force is applied thereto by a user; a counterweight, separate from said source of resistance, coupled to the cable for retaining the cable in a retracted position when it is not being pulled by a user; and a one-step combination trolley locking and cable take-up mechanism for controlling the position and retraction of the cable to maintain the proximal end of the cable close to the trolley when the trolley is repositioned and no tensile force is applied by the user.

26. Exercise equipment as claimed in claim **25**, wherein the source of resistance is variable.

27. Exercise equipment as claimed in claim **26**, further comprising a counter-resistance which retains the cable in a retracted position when it is not being pulled by a user.

28. Exercise equipment as claimed in claim **26**, wherein the source of resistance includes a set of weights which are lifted when the cable is pulled by a user.

29. Exercise equipment as claimed in claim **25**, wherein there is a second exercise equipment as recited in claim **25**, positioned adjacent a first exercise equipment as recited in claim **25**, said first and second exercise equipment being capable of being used simultaneously by a single user exercising two limbs or other parts of his body simultaneously or by two users simultaneously.

30. Exercise equipment as claimed in claim **29**, wherein the first and second exercise equipment are placed side-by-side at a selected relative angle.

31. Exercise equipment as claimed in claim **29**, wherein the two units of first and second exercise equipment are integrated into a unitary construction.

32. Exercise equipment as claimed in claim **25**, further comprising a chair or bench positioned adjacent the exercise equipment to enable a user to exert a tensile force to the cable while sitting or lying down.

33. Exercise equipment as claimed in claim **25**, further comprising at least one rub block at the exit point of said cable.

34. Exercise equipment as claimed in claim **25**, wherein a pair of pulleys is disposed at said cable exit point.

35. Exercise equipment as claimed in claim **34**, further comprising a pair of rollers at the exit point of said cable, said rollers having roller axes which are substantially parallel and substantially perpendicular to axes of said pulleys.

36. Exercise equipment as claimed in claim **34**, further comprising a second pair of pulleys at said at least one exit point of said cables, said second pair of pulleys having pulley axes which are substantially parallel and substantially perpendicular to axes of said first pair of pulleys.

37. Exercise equipment as claimed in claim **25**, wherein the device that enables the user to exert a tensile force to the cable is selected from the group consisting of a handle, strap, belt, rope, bar and leg curl.

38. Exercise equipment as claimed in claim **37**, further comprising racks for holding handles, grips, bars and other attachments.

39. Three-dimensional pulley cable exercise equipment having at least one swiveling element mounted on a frame to form an exit point of a cable; at least one cable, with a distal end and a proximal end, the distal end of the cable being attached to a source of resistance and the proximal end of the cable exiting the equipment past said swiveling element; and means to indicate a three-dimensional position of the exiting cable, whereby the three-dimensional position of the cable may be recorded.

40. Exercise equipment as recited in claim **39**, wherein said swiveling element includes at least one pulley.

41. Exercise equipment as claimed in claim **40**, wherein said at least one pulley includes at least three pulleys, two of which are arranged with their axes substantially in parallel.

42. Exercise equipment as claimed in claim **41**, wherein said at least one pulley includes two pairs of pulleys, each pair having substantially parallel axes, with the axes of one pair being substantially perpendicular to the axes of the other pair.

43. Exercise equipment as claimed in claim **40**, wherein said at least one pulley includes at least two pulleys which are arranged with their axes substantially in parallel.

44. Exercise equipment including a framed housing having a curved path, at least one cable exit point selectively positioned along the curved path, said exit point having passed therethrough a cable having a proximal end and a distal end, the proximal end being located outside the curved path and attached to means that enables a user to exert a tensile force to the cable against a selected resistance, with the distal end being coupled to a source of said selected resistance, such that when the proximal end of the cable is pulled by a user, the resistance exerts a counterforce at the distal end; and cable take-up means, disposed between the proximal end and the distal end, for maintaining the length of the cable between its proximal end and the exit point through which it passes substantially constant, independent of the position of the exit point along the curved path, when no tensile force is applied thereto by a user and operating simultaneously with any repositioning of the cable exit point along the curved path.

45. Exercise equipment as claimed in claim **44**, further comprising at least one rub block at the exit point of said cable.

46. Exercise equipment as claimed in claim **44**, wherein a pair of pulleys is disposed at said cable exit point.

47. Exercise equipment as claimed in claim **46**, further comprising a second pair of pulleys at said at least one exit point of said cables, said second pair of pulleys having pulley axes which are substantially parallel and substantially perpendicular to axes of said first pair of pulleys.

48. Exercise equipment including a housing having a structural surface defining a prescribed contour, multiple cable exit points positioned along the structural surface, each exit point having passed therethrough a cable having a proximal end and a distal end, the proximal end of each cable being located outside the structural surface and being attached to a device that enables a user to exert a tensile force to the cable by pulling the cable in any desired direction, the distal end of each cable being coupled to a common source of resistance within the housing such that when the proximal end of each cable is pulled by a user, the resistance exerts a counterforce to such cable, and means for retaining each cable in a retracted position, when it is not being pulled by a user, even when one or more other cables are pulled by a user.

49. Exercise equipment as claimed in claim **48**, wherein the source of resistance is variable.

50. Exercise equipment as claimed in claim **48**, wherein the source of resistance includes a set of weights which are lifted when said proximal end of each cable is pulled by a user.

51. Exercise equipment as claimed in claim **50**, wherein said retaining means comprises at least one counterweight which retains the cables in a retracted position when they are not being pulled by a user.

52. Exercise equipment as claimed in claim **51**, wherein each cable, from its proximal end to its distal end, passes through the exit point and then passes through a series of pulleys, the distal end of each cable being attached to a counterweight housed within a vertical set of guide tracks; a horizontal plate with openings therein for passage of the cables therethrough, the plate being positioned above the counterweights and extending over and attached to a vertically positioned guide means traveling along a vertical shaft positioned between the set of weights and the counterweights, the plate being extended to reach out over the set of weights and being fastened to a set of guide tubes which guide the set of weights vertically along two upright guide rods extending downward through the set of weights; and a rod extending downward through a center of the set of weights with holes cut in it to allow a selector pin to slide into the set of weights so the user can select the desired weight to lift so that when the user pulls on the cable proximal end at a point of egress, the counterweight is lifted thereby lifting the horizontal plate assembly and a selected weight, other cables in the system not engaged by a user at that time being held in the ready position by their respective counterweights.

53. Exercise equipment as claimed in claim **52**, wherein there is a second exercise equipment as recited in claim **50** positioned adjacent a first exercise equipment as recited in claim **50**, said first and second exercise equipment being capable of being used simultaneously by a single user exercising two limbs or other parts of his body simultaneously or by two users simultaneously.

54. Exercise equipment as claimed in claim **53**, wherein the first and second exercise equipment are placed side-by-side at a selected relative angle.

55. Exercise equipment as claimed in claim **53**, wherein the first and second exercise equipment are integrated into a unitary construction.

56. Exercise equipment as claimed in claim **53**, further comprising a chair or bench positioned adjacent the exercise equipment to enable a user to exert a tensile force to a cable while sitting or lying down.

57. Exercise equipment as claimed in claim **50**, wherein the source of resistance includes a set of weights are lifted when said proximal ends of a plurality of said cables are pulled by a user.

58. Exercise equipment as claimed in claim **48**, wherein the device that enables the user to exert a tensile force to a cable is selected from the group consisting of a handle, strap, belt, rope, bar and leg curl.

59. Exercise equipment as claimed in claim **58**, further comprising racks for holding handles, grips, bars and other attachments.

60. Exercise equipment as claimed in claim **48**, wherein there is a second exercise equipment as recited in claim **13** positioned adjacent a first exercise equipment as recited in claim **13**, said first and second exercise equipment being capable of being used simultaneously by a single user exercising two limbs or other parts of his body simultaneously or by two users simultaneously.

61. Exercise equipment as claimed in claim **60**, wherein the first and second exercise equipment are placed side-by-side at a selected relative angle.

62. Exercise equipment as claimed in claim **60**, wherein the first and second exercise equipment are integrated into a unitary construction.

63. Exercise equipment as claimed in claim **48**, further comprising a chair or bench positioned adjacent the exercise equipment to enable a user to exert a tensile force to a cable while sitting or lying down.

64. An exercise equipment as claimed in claim **50**, wherein the distal end of each cable is attached to a counter-resistance positioned next to the source of resistance, but before being attached to the counter-resistances the cables pass through or by a substantially horizontal plate which is positioned above the counter-resistances and attached to a substantially vertically positioned guiding means traveling along a substantially vertical path next to the source of resistance, a single cable being attached to the underside of the substantially horizontal plate and directed downward to and over a third pulley below, redirected by fourth pulleys to the source of resistance, so that when the user selects a particular resistance to lift at a particular egress point, the user pulls the proximal end of a particular cable external to the exercise equipment, the counter-resistance at the distal end of this cable lifts the substantially horizontal plate which, in turn, pulls on the single cable below which lifts the source of resistance, while other cables in the equipment which are not engaged by the user at that time are held in place by their respective counter-resistances.

65. Exercise equipment as claimed in claim **48**, wherein a pair of pulleys are disposed at at least one cable exit point.

66. Exercise equipment as claimed in claim **65**, further comprising a pair of rollers at said at least one exit point of said cables, said rollers having roller axes which are substantially parallel and substantially perpendicular to axes of said pulleys.

67. Exercise equipment as claimed in claim **65**, further comprising a second pair of pulleys at said at least one exit point of said cables, said second pair of pulleys having pulley axes which are substantially parallel and substantially perpendicular to axes of said first pair of pulleys.

68. Exercise equipment as claimed in claim **48**, further comprising at least one rub block at the exit point of said cables.

69. Exercise equipment as claimed in claim **48**, wherein the cable length between the proximal end of each cable and its associated exit point through which it passes is substantially equal, when no tensile force is applied thereto by a user.

70. Exercise equipment as claimed in claim **48**, wherein said prescribe contour is arcuate.

71. Exercise equipment as claimed in claim **48**, wherein said retaining means includes means for distributing the source of resistance between any or all of the cables to which a tensile force is applied by a user.

* * * * *

APPENDIX EE

US008608626B2

(12) **United States Patent**
Campbell

(10) **Patent No.: US 8,608,626 B2**
(45) **Date of Patent: Dec. 17, 2013**

(54) **ROWING MACHINE SIMULATOR**

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A63B 69/06 (2006.01)

(52) **U.S. Cl.**
USPC **482/72**

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USPC 482/51, 72, 73, 110, 111; D21/674
See application file for complete search history.

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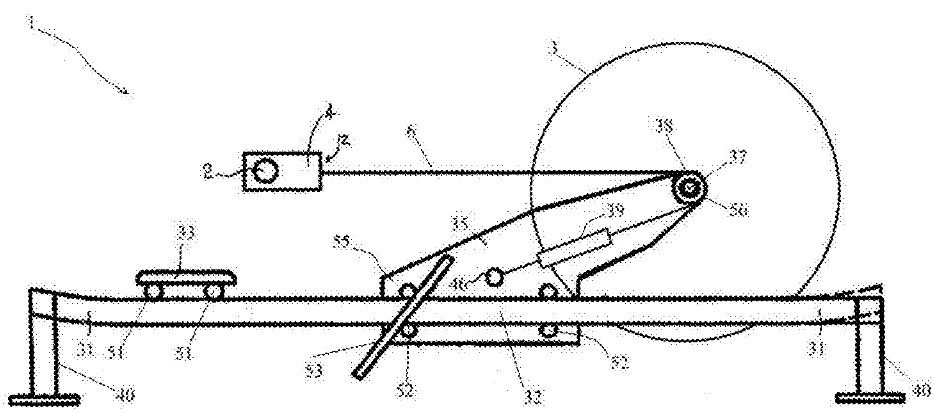
(57) **ABSTRACT**

One aspect is a rowing machine with a longitudinally extending beam and a seat mounted to said beam and slidable therealong. A frame is mounted to said beam and slidably movable therealong independently of said seat. A pair of foot rests are mounted to a user end of said frame. A flywheel is rotatably mounted by a flywheel shaft to said frame, said flywheel shaft mounted to said frame a height less than a radius of said flywheel above said beam. The flywheel is drivable by a cable through a transmission mechanism mounted to said frame such that one end of said cable remote from said flywheel is connected to a handgrip and the other end of said cable connected to a cable take up mechanism.

11 Claims, 9 Drawing Sheets



Nautilus Exhibit 1007

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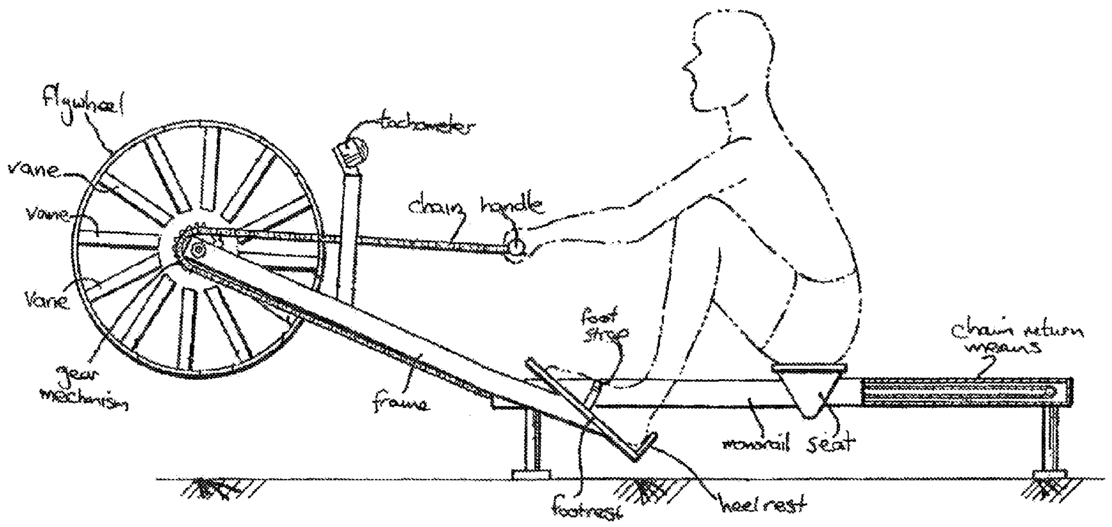

FIG. 1 PRIOR ART

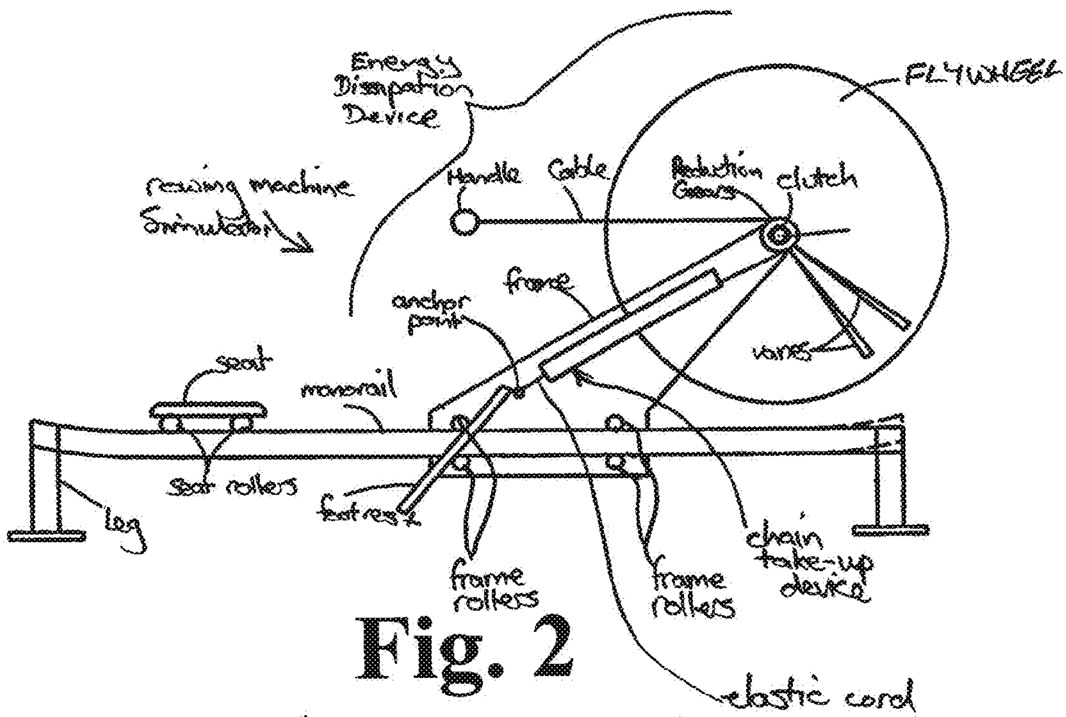

Fig. 2

(PRIOR ART)

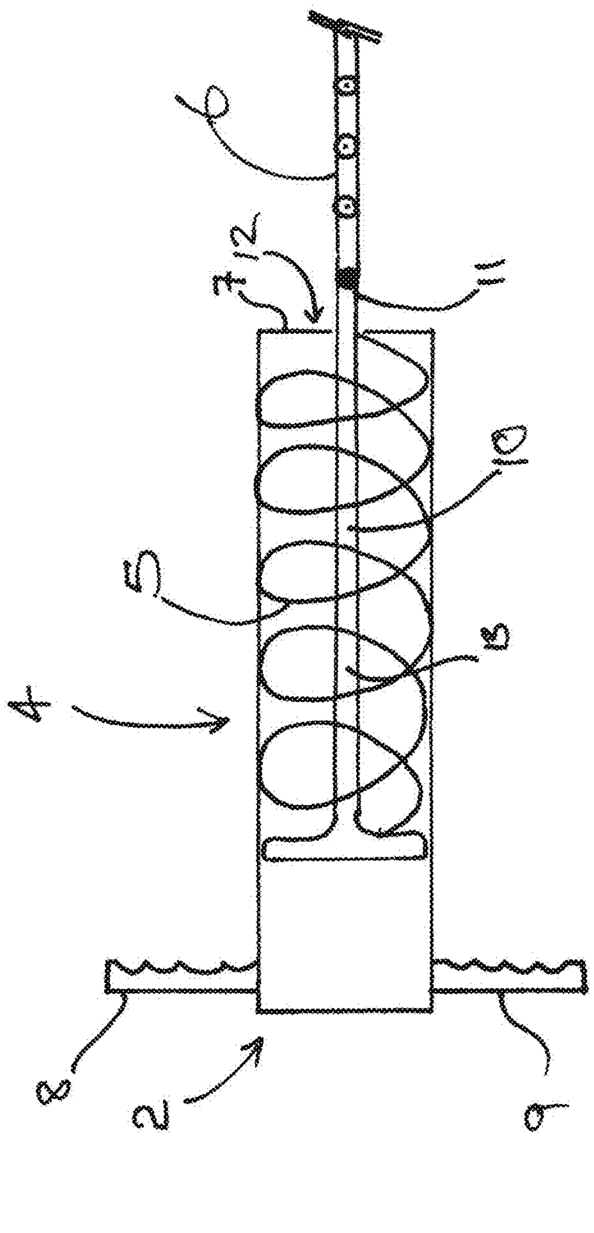

FIG. 3

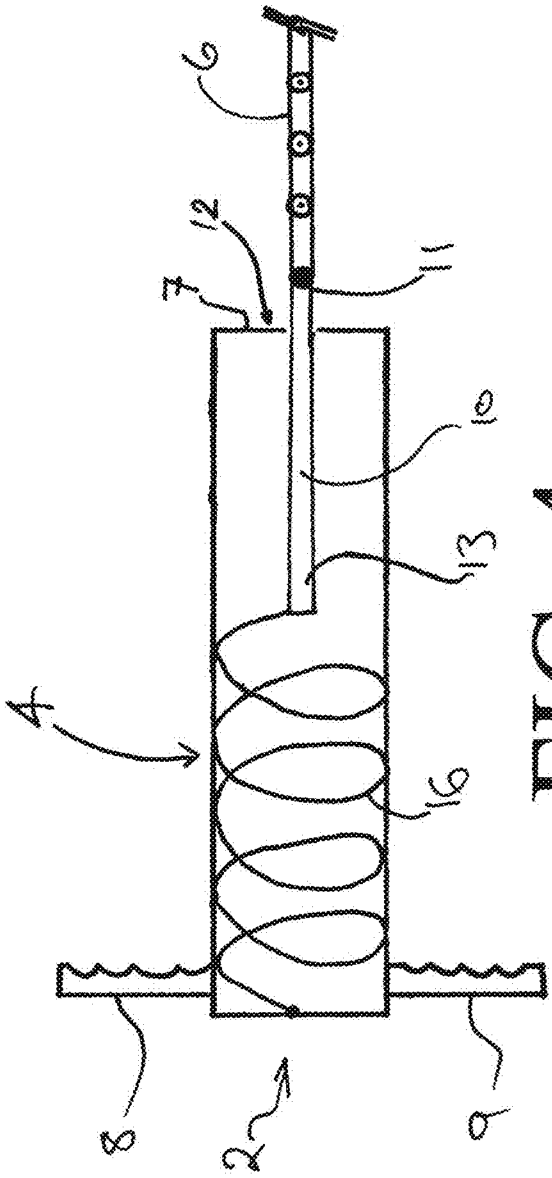

FIG. 4

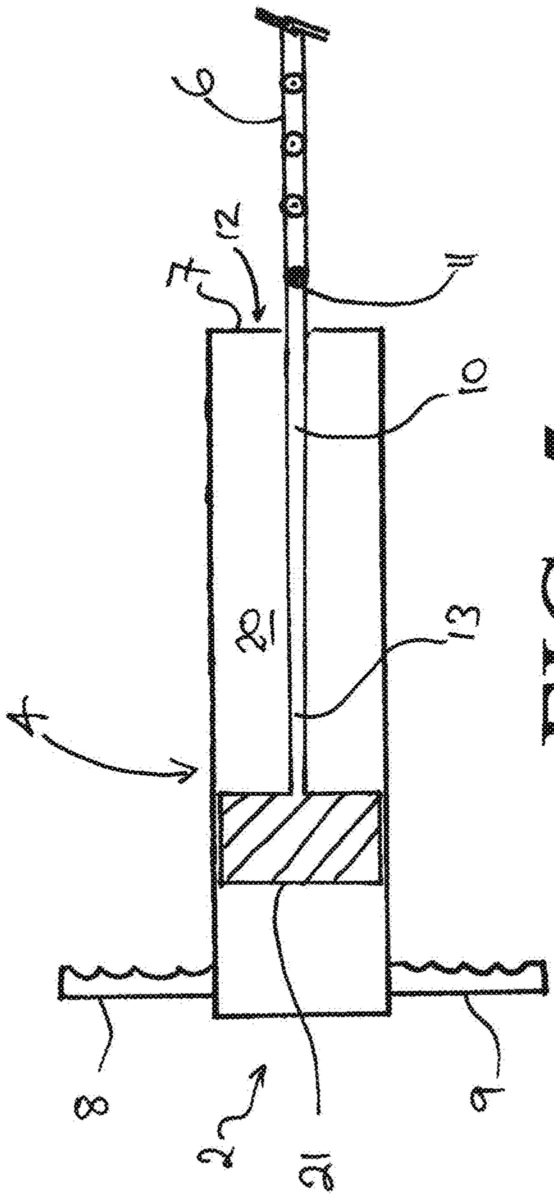

FIG. 5

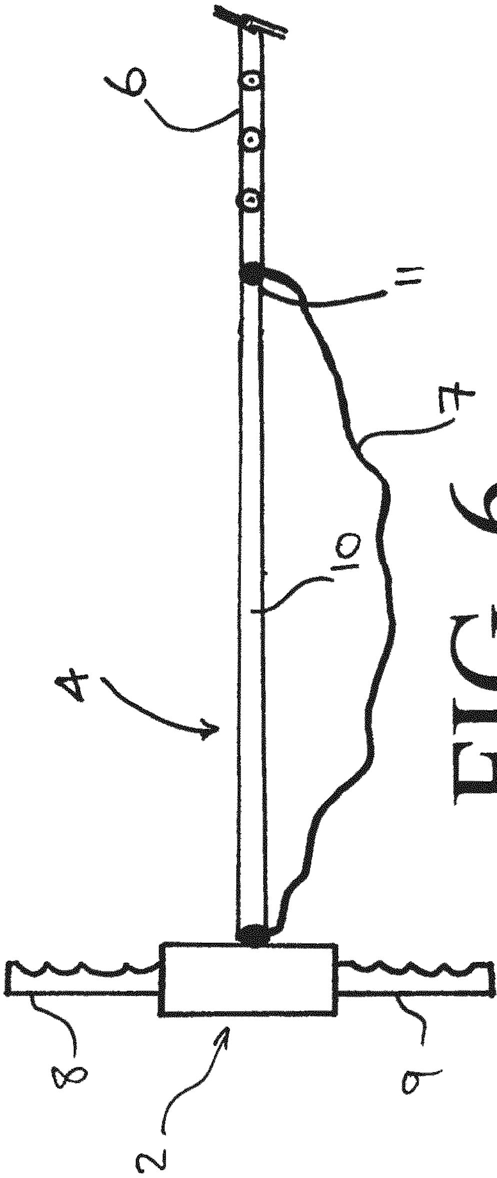

FIG. 6

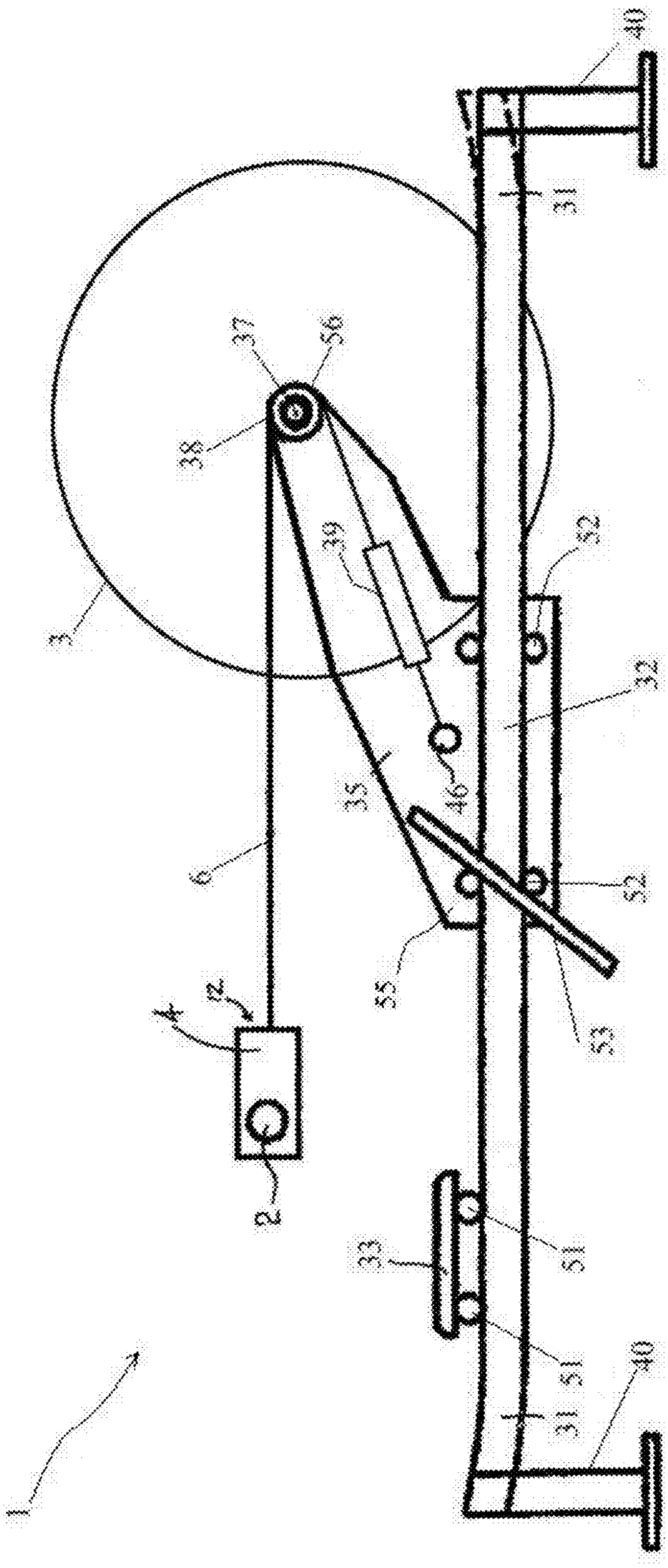

FIG. 7

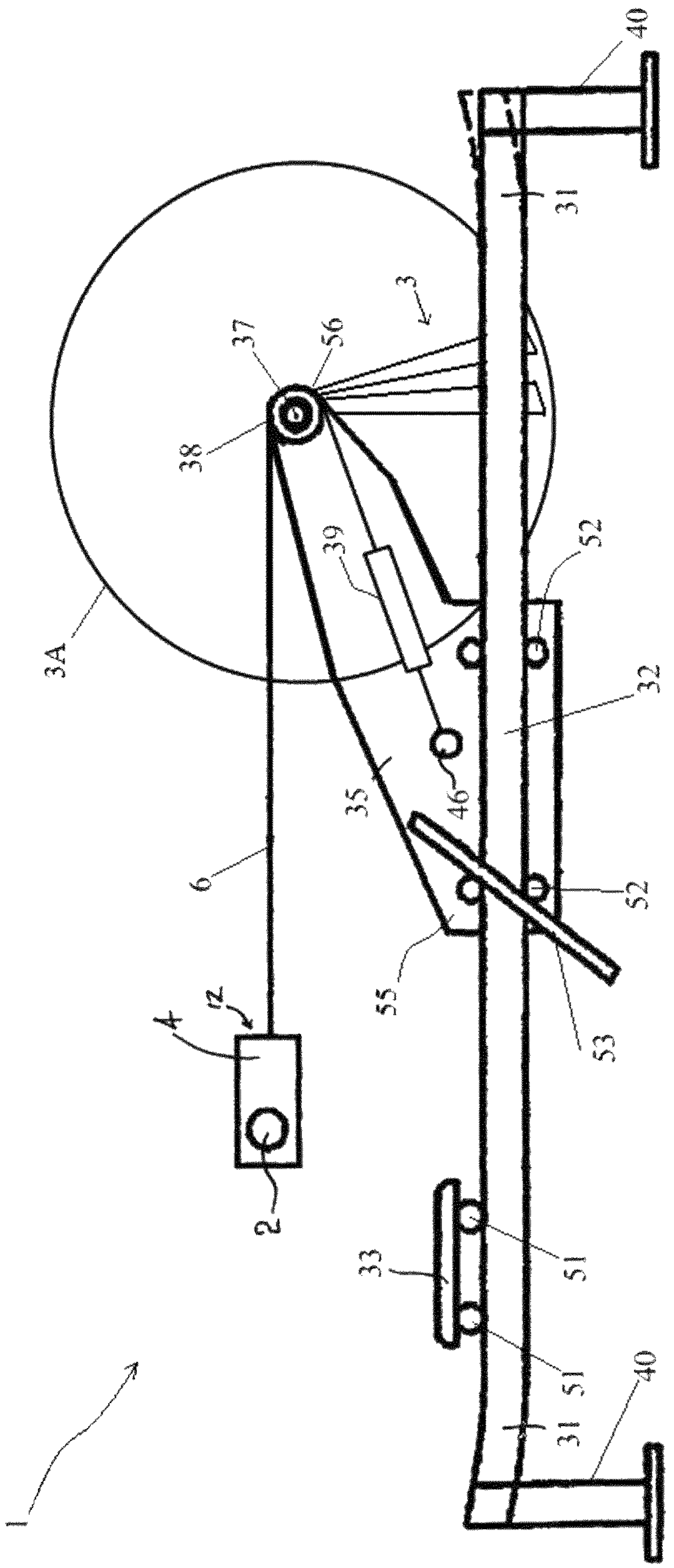

FIG. 8

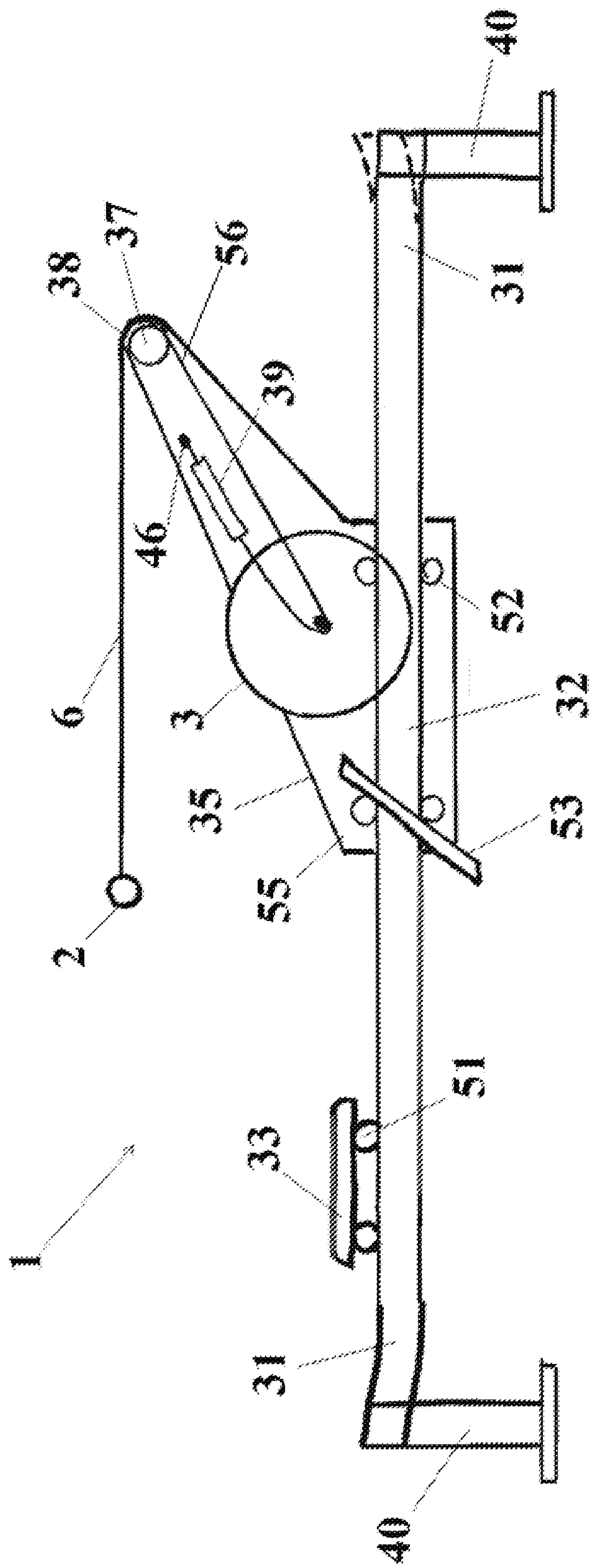

FIG. 9

ROWING MACHINE SIMULATOR

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a Continuation-in-Part of patent application Ser. No. 12/018,702, filed Jan. 23, 2008 entitled, "Rowing Machine Simulator," which claims priority to Australian Provisional Patent Application No. 2007900315 filed Jan. 23, 2007, all of which are incorporated herein by reference.

BACKGROUND

One aspect relates to rowing simulators or rowing machines. One embodiment has been developed primarily for use with dynamically balanced rowing simulators and will be described hereinafter with reference to this application. However, it will be appreciated that the invention is not limited to this particular field of use and is applicable to many different types of rowing simulators as would be understood by a person skilled in the art.

Static rowing simulators or machines have been long known for use in both general strength and fitness training, or for use specifically for oarsmen to practice their rowing. In these known static simulators, a seat is slideably mounted to a rail so as to simulate the sliding motion of a seat in a rowing boat. A typical example of a static rowing machine simulator can be found in U.S. Pat. No. 4,396,188, and reference is made to FIG. **1** which reproduces a drawing from this US prior art patent.

As shown in FIG. **1**, the static rowing simulator includes an energy dissipation device in the form of a flywheel that is driven by a chain connected to a handle in front of a rower. When the rower is seated on the sliding seat, the feet are placed on footrests which are attached to the frame upon which the seat slides. A rowing or pulling motion on the handle causes the chain to move and thereby rotate the flywheel.

Unfortunately, static rowing simulators such as the example shown in FIG. **1** do not properly simulate the forces an oarsman is exposed to during normal rowing action. As such, the known static rowing simulators are acknowledged by health professionals as being potentially detrimental to the oarsman by increasing the likelihood of injury to the oarsman's knee, back and shoulders.

In order to more accurately simulate the forces that would be experienced by an oarsman in a boat, the subject of U.S. Pat. No. 5,382,210 (Rekers) was developed. A right hand side view of the Rekers simulator is shown in FIG. **2**. The disclosure of the specification of the Rekers US patent is hereby incorporated herein in its entirety.

In a dynamically balanced rowing machine simulator such as Rekers, the energy dissipation device (flywheel) is also slideably mounted to the frame independent of the sliding movement of the seat. That is, during use by an oarsman, the slideably mounted seat and energy dissipation device move independently of each other apart and together as a function of the stroke of the oarsman. In the Rekers prior art, the dynamically balanced rowing machine simulator stabilizes the energy dissipation device (flywheel) and the oarsman independent of internal friction and/or hysteresis in any elastic elements in the simulators.

It will be appreciated by those skilled in the art that when an oarsman sits on the seat of the simulator of the Rekers patent, they place their feet on the foot rests which are slideably mounted with the energy dissipation device flywheel so that pulling on the rowing machine simulator handle and release thereof causes the energy dissipation device and seat to move apart and together during the initial stages of a stroke and the final stages of a stroke respectively. It is known that the disclosure of rowing machine simulators such as those of the Rekers patent provides significant improvements in the simulation of the experience an oarsman would receive when rowing a boat on the water as not only is the movement of the sliding seat simulated, but also the movement of the boat by means of the movement of the energy dissipation device (flywheel). Use of simulators such as those of Rekers reduces the risk of injury that is presented by the use of static simulators.

Whilst the rowing machine simulators of the type disclosed in the Rekers patent are significant improvements over what is known, it would be preferable to have a rowing machine simulator which yet more realistically simulates the experiences of an oarsman rowing a boat on the water. As would be understood by a person skilled in the art, other conventionally known dynamically balanced rowing machine simulators typically only address one or two specific conditions experienced during an oarsman rowing. Another disadvantage of the prior art is a propensity to become unstable during use when an oarsman is pulling on the handle.

The genesis of one embodiment is a desire to provide an improved dynamically balanced rowing machine simulator, or to provide a useful alternative.

SUMMARY OF THE INVENTION

According to an aspect of the invention there is provided a rowing machine comprising:

a longitudinally extending beam;

a seat mounted to said beam and slidable therealong;

a frame mounted to said beam and slidably movable therealong independently of said seat;

a pair foot rests mounted to a user end of said frame;

a flywheel rotatably mounted by a flywheel shaft to said frame, said flywheel shaft mounted to said frame a height less than a radius of said flywheel above said beam; and

wherein said flywheel is drivable by a cable through a transmission mechanism mounted to said frame such that one end of said cable remote from said flywheel is connected to a handgrip and the other end of said cable connected to a cable take up mechanism.

It will be appreciated by those skilled in the art that use of the dynamically balanced rowing machine simulator with the flywheel configuration disposed at a height of less than a radius thereof provides a more stable simulator. This also advantageously provides a reduced operating arc regiment being about the approximate flywheel radius.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings are included to provide a further understanding of embodiments and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments and together with the description serve to explain principles of embodiments. Other embodiments and many of the intended advantages of embodiments will be readily appreciated as they become better understood by reference to the following detailed description. The elements of the drawings are not necessarily to scale relative to each other. Like reference numerals designate corresponding similar parts.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which,

FIG. **1** is a left-hand side view of a static rowing machine simulator known to the prior art;

FIG. **2** is a right-hand side view of a dynamically balanced rowing machine simulator known to the prior art;

FIG. **3** is a schematic top view of an energy storage device according to a preferred embodiment for use in a rowing machine simulator;

FIG. **4** is a schematic top view of an energy storage device according to another preferred embodiment for use in a rowing machine simulator;

FIG. **5** is an energy storage device according to another preferred embodiment for use in a rowing machine simulator;

FIG. **6** is a schematic top view of an energy storage device according to a further preferred embodiment for use in a rowing machine simulator; and

FIG. **7** is a side view of a rowing machine simulator according to a further preferred embodiment of the invention;

FIG. **8** is a side view of a rowing machine simulator similar to FIG. **7** with a different flywheel; and

FIG. **9** is a side view of a rowing machine simulator according to another preferred embodiment of the invention.

DETAILED DESCRIPTION

In the following Detailed Description, reference is made to the accompanying drawings, which form a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. In this regard, directional terminology, such as "top," "bottom," "front," "back," "leading," "trailing," etc., is used with reference to the orientation of the Figure(s) being described. Because components of embodiments can be positioned in a number of different orientations, the directional terminology is used for purposes of illustration and is in no way limiting. It is to be understood that other embodiments may be utilized and structural or logical changes may be made without departing from the scope of the present invention. The following detailed description, therefore, is not to be taken in a limiting sense, and the scope of the present invention is defined by the appended claims.

It is to be understood that the features of the various exemplary embodiments described herein may be combined with each other, unless specifically noted otherwise.

Referring to FIGS. **3** to **9** generally, like reference numerals have been used to denote like components. Referring firstly to FIG. **7**, there is shown a rowing machine simulator **1** having a rowing handle **2** which is connected to a dynamically mounted energy dissipation device **3**. It will be appreciated that the rowing machine simulator **1** can be a machine in which the energy dissipation device **3** is static and not moveable.

The rowing machine simulator **1** includes an energy storage device **4**. The energy storage device **4** is configured to be disposed intermediate the rowing machine simulator handle **2** and the energy dissipation device **3**. The energy storage device **4** is configured to elastically absorb a proportion of the force applied to the rowing handle **2** by an oarsman (not illustrated) during the early phase of a simulated rowing stroke. The elastically stored energy in the device **4** is released during later phases of the simulated rowing stroke when the force applied by the oarsman reduces below a pre-determined force.

The energy storage device **4** is adapted to absorb between 15% to 35% of the force applied to the rowing handle **2** by an oarsman during the early phase of a stroke. In the preferred embodiment of FIG. **3**, the energy storage device **4** is configured to elastically absorb the instantaneous force applied by an oarsman during approximately the first 20% to 80% of the simulated rowing stroke. Most preferably, the storage device **4** is configured to elastically absorb the instantaneous force applied by the oarsman during approximately the first 40% of a stroke.

In the preferred embodiment of FIG. **3**, the energy storage device **4** is configured to elastically absorb instantaneous force applied by the oarsman during the early phase of the stroke of between 200 N to 1200 N. In other preferred embodiments, not illustrated, the energy storage device **4** is configured to elastically absorb instantaneous force applied by the oarsman of between 400 N to 800 N.

It will also be appreciated that the energy storage device **4** can include a variable energy storage capacity to absorb instantaneous forces during the early phases of a stroke applied by oarsmen having different strengths. It will also be appreciated that the energy dissipation device **3** is configured to simulate the pre-determined or preferred mass of a rowing boat with or without rowers and/or a coxswain. That is, the energy dissipation device **3** can be selected to correspond to the mass of a lightweight scull, or, if preferred a heavier boat, or indeed any preferred weight.

In the preferred embodiment of FIG. **3**, the energy storage device **4** is in the form of a compression spring **5** that is configured to be connected to the rowing handle at one end and to a cable connected to the energy dissipation device **3** at the other end. It will be appreciated that the cable **6** can be indirectly connected to the energy dissipation device **3**, as shown in FIG. **7**, or it can be directly connected to the energy dissipation device **3** (not illustrated) as preferred.

It will also be appreciated that the cable **6** can be a chain, belt or other connection means connected to the energy dissipation device at the other end and the handle at one end. The cable could be a combination of a cable, a chain, a belt and/or other connection means as preferred and as would be appreciated by a person skilled in the art.

The energy storage device **4** includes a stop means **7** to limit the compression of the compression spring **5** during absorption of instantaneous force applied by the rower to the handle **2**. The stop means **7**, as shown in FIG. **3**, most preferably limits the total compression of the spring **5**.

As schematically shown in FIG. **7**, the energy storage device **4** is disposed within a housing formed by the rowing machine simulator handle **2**. The handle **2** includes a left handgrip **8** (not illustrated) spaced apart from a right handgrip **9**. A shaft **10** is disposed intermediate the left and right hand handgrips **8** and **9** wherein a head **11** of the shaft **10** extends from a front **12** of the handle **2** and is releasably connected to the chain **6**. The shaft **10** includes a shank end **13** configured to be substantially disposed within the handle **2**.

The shank end **13** is slideably mounted within the handle between a non-energy storage position, as shown in FIG. **3**, and an energy storage position (not illustrated) wherein the shank **13** is resiliently biased by compression spring **5** towards the non-energy storage position. It will be appreciated that the shank **13** can be configured to protrude a predetermined distance from the handle **2** rather than simply being substantially enclosed within the handle.

In use, the oarsman places each hand on the respective handle handgrips **8** and **9** and applies a pulling force thereto. During the early phases of the stroke, the compression spring **5** is caused to compress and store energy thereby elastically absorbing a proportion of the force applied to the handle by the oarsman. Once the oarsman ceases applying a force of a pre-determined magnitude or greater, the compression spring **5** being under compression will recoil. This happens during a later phase of the simulated rowing stroke and most preferably during the final 60% of the stroke.

In this way, it will be appreciated that the energy storage device allows the simulation of some forces experienced by an oarsman when rowing a boat on water. That is, elastic flexing experienced by an oarsman when rowing on the water with real oars in a real boat. It will be appreciated that the shaft **10** can include a hook, clip or other fixed or releasable fastening means to connect the energy storage device **4** to the chain **6**.

Referring now to FIG. **4**, there is shown a top view of an energy storage device according to another preferred embodiment of the invention for use in a rowing machine simulator. The rowing machine simulator can be a static or dynamically balanced simulator.

In the embodiment of FIG. **4**, an expansion spring **16** is configured to be connected intermediate the handle **2** and the energy dissipation device **3** of the rowing machine simulator (not illustrated). In this preferred embodiment, the energy storage device is configured to be disposed within the rowing machine simulator handle (not illustrated) and be releasably connected to the chain **6** at the shaft head **11**.

In use, one end of the expansion spring **16** is connected to the handle of the rowing machine simulator and the other end connected to the cable such that application of force by the oarsman on the handle causes the expansion spring to elastically absorb energy. As in the case with the preferred embodiment of the energy storage device **4** described with reference to FIG. **3** using a compression spring **5**, a stop means **7** is employed to prevent the expansion spring being stretched beyond its elastic limit.

The energy storage device **4** using the expansion spring **16** is configured to absorb about the same amount of force applied by the oarsman to the handle during the early phase of a stroke as is described for the energy storage device **4** with reference to FIG. **3**.

In FIG. **5**, there is shown another preferred embodiment of the energy storage device **4** in the form of a pneumatic piston and cylinder **20** and **21** respectively. As with the other preferred embodiments, the energy storage device **4** of FIG. **5** is configured to be connected to the rowing handle at one end and to a cable (not illustrated) at the other end which is in turn connected to the energy dissipation device of the rowing machine simulator. In this way, force applied by an oarsman simulating the rowing stroke causes the cylinder and the piston to be pulled apart and to elastically absorb the energy applied during the early phases of the stroke. Once the force applied by the rower reduces below a pre-determined magnitude, the piston and cylinder are caused to return to their initial positions thereby releasing the stored energy. It will be appreciated that the energy storage device **4** of FIG. **5** performs the same function as the preferred embodiments of FIGS. **3** and **4**.

Referring to FIG. **6**, there is shown yet another preferred embodiment of the energy storage device **4**. In this embodiment, the energy storage device **4** is not configured to be disposed within the handle **2** but is most preferably configured to connect at one end to the handle and to a cable connected to the energy dissipation device at the other end. The energy storage device **4** is in the form of an elastically deformable elastomeric material which is configured to absorb between 15% to 35% of the force applied to the rowing handle by the oarsman during the first 40% of a rowing stroke. In this embodiment, a substantially inelastic cable **7** is attached to or adjacent to each end of the elastomeric cable **4** to act as a stop **7** to prevent over-extension of the energy storage device **4**.

As with the other embodiments of the energy storage device **4** described above, the elastomeric material can be configured to elastically absorb force applied by the oarsman during the first 20 to 80% of the stroke where the oarsman is applying between 200 N to 1200 N of force to the handle. In this way, the material elastically stretches and elastically absorbs the applied force releasing it when the force applied by the oarsman reduces below a pre-determined value.

It will also be appreciated that the preferred embodiments of the energy storage device **4** shown in FIGS. **4** to **6** also advantageously provide the simulation of some of the forces experienced by an oarsman when rowing a boat on the water, for example, the flexing forces of an outrigger canoe.

Referring now to FIG. **7**, there is shown a rowing machine simulator **1** according to another preferred embodiment. The simulator **1** includes an energy storage device **4** as shown but this is optional and can be removed with the user end of cable **6** connected directly to handle **2**.

The rowing machine simulator **1** includes a beam **31** having a pre-determined length and a substantially horizontal central portion **32**. The ends of the beam **31** are supported by legs **40**. The ends of the beam **31** are each preferably curved upwardly by some amount.

The simulator **1** includes a seat **33** mounted by wheels or rollers **51** to the beam **31**. This allows the seat **33** to horizontally slidably move along the beam **31**. The seat **33** is disposed a pre-determined height above the beam.

A frame **35** is mounted to the beam **31** by wheels or rollers **52**. The frame **35** is slidably movable along the beam **31** independently of movement of the seat **33**. A pair foot rests **53** (right hand foot rest **53** shown in the side view of FIG. **7**) are mounted to a user end **55** of the frame **35**. Each foot rest **53** extends outwardly from the frame **35** in a direction substantially perpendicular to the beam **31**. The foot rests **53** extend a predetermined distance from the frame **35**.

A flywheel **3** is rotatably mounted by a flywheel shaft **37** to the frame **35** at or adjacent an end **56** of the frame **35** distal the user end **55**. The flywheel **3** is most preferably a solid circular disc but may be have apertures or be perforated. Further, the flywheel **3** may include a plurality of radially outwardly extending vanes that may be surrounded by an enclosure as shown in FIG. **8** where the ends of the vane define the flywheel radius which is smaller than the radius of the vaned flywheel cage denoted **3**A in FIG. **8**.

The flywheel **3** is mounted a height above the beam **31** of less than a radius of the flywheel **3**. That is, the shaft **37** is held above the beam **31** a height of less than a radius of the flywheel. In the most preferred embodiments, the flywheel shaft **37** is disposed a height of between 5% to 90% of the flywheel radius **3** above the beam **31**. However, it will be appreciated that the flywheel shaft **37** can be mounted to the frame **35** a height less than a radius of said flywheel above said beam including at the same height or where the shaft **37** is lower than the beam **31**.

The flywheel **3** is driven by a cable **6** through a transmission mechanism in the form of a sprocket gear **38** mounted about the shaft **37**. The sprocket **38** is able to rotate in one direction, being anti-clockwise in FIG. **7**, to rotate the flywheel **3**. Rotation of the sprocket **38** in the clockwise direction results in substantially free rotation of the sprocket **38** which allows for the take up of the cable **6**.

One end of the cable **6** remote from the flywheel **3** is connected to a handgrip **2** for use by an oarsman seated on the seat **33**. The other end of the cable **6** is connected to a cable take up mechanism **39**.

The cable **6** is formed from twisted metal wires between the handle **2** and adjacent the sprocket **38** and is then formed from a chain which engages about teeth of the sprocket **38** and connects to the cable take up mechanism **39** either directly as shown in the drawings or via a cable portion connected to the chain portion and being formed from twisted metal wires. It will be appreciated that the cable **6** can be formed from any preferred material such as twisted or braided metal or fibre wires, chain, belt, cord, or any preferred combination of them.

The chain take up mechanism **39** is mounted to the frame **35** and the cable **6** is secured at anchor point **46** on the frame **35**. The take up mechanism **39** includes a constant tension spring element (shown schematically in FIG. **7**). In other preferred embodiments, not illustrated, the chain portion of the cable **6** adjacent the take up mechanism **39** is coupled to an elastic cord which is wound around a plurality of pulleys and then mounted to the frame **35** at anchor **46**. Alternatively, the chain take up mechanism may be of the kind shown in FIG. **1** or any preferred conventional take up mechanism.

In use, an oarsman sits on seat **33**, places each foot on a foot rest **53** and grasps handle **2**. The oarsman pulls on the handle **2** causing the cable **6** to rotate the sprocket **38** and the flywheel **3** to rotate anti-clockwise and by doing so dissipating energy. The seat **33** and the frame **35** move away from each other when the oarsman pulls the cable **6**. When the oarsman ends the pull stroke, the cable take up mechanism **39** retracts the cable **6** and the seat **33** and frame **35** move toward each other as the oarsman bends their knees. The take up mechanism **39** maintains the cable **6** under constant tension.

It will therefore be seen that disposing the flywheel shaft **37** at a vertical height above the frame **35** being less than a radius of the flywheel **36** that a more stable rowing machine simulator **1** is advantageously provided. The flywheel **3** can be solid or substantially solid and with or without an enclosure or cage, or be of the kind with vanes (FIG. **8**) as desired. The preferred embodiment of FIG. **1** shows a flywheel **3** with radially extending vanes (only two selected vanes shown).

Although not illustrated, it will be appreciated that the frame **35** can include an arm extending therefrom to support the flywheel shaft **37** at the predetermined height. Likewise, the transmission mechanism for converting linear motion of the cable **6** to rotation of the flywheel **3** can be any desired such as a roller mounted to the flywheel with the cable **6** wrapped around it. Further, it will also be appreciated that the beam **31** can be replaced with a pair of spaced apart parallel beams in which the seat **33** and the frame **35** each mount to both beams.

It will also be appreciated that in some preferred embodiments that an indirect drive means (not illustrated) can be disposed intermediate the handle **2**/chain **6** and the drive means **38**. In this way, the handle can be geared up or down to provide the required resistance. For example, the indirect drive means may be disposed at a vertical height above the beam **31** and the flywheel shaft **37** and the chain **6** may loop over the indirect drive means and then over the flywheel sprocket gear **38**. This is most advantageous when the flywheel shaft **37** is some relatively close height above the beam **31**, for example where the flywheel shaft **37** is say a height of 40% to 50% of the flywheel radius above the beam, and the handle **2** would be uncomfortably low relative to the height of the flywheel shaft **37**.

The use of the flywheel **3** in this position results in greater stability, making the machine **1** safer in that it is less likely to topple over than conventional rowing simulator machines. With prior art rowing machine simulators, even the smallest lift could result in the machine toppling over (usually damaged in that fall). This resulted in a perception of fault lying with the machine. With the rowing machine **1** of the preferred embodiment of FIG. **7** to **9** resistance to toppling is relatively high with the result is that it takes quite a relatively large tilt before toppling. Further, a small tilt will not topple the machine **1** unlike in the prior art so that a clear indication is provided to the person lifting the machine **1** before it could topple. That is, the person lifting the machine **1** will feel the machine **1** become unstable through tipping and have time to stop and react.

It will be understood that the change in geometry practically reduces the centre of gravity and produces a more stable simulator. Furthermore, this most advantageously reduces the size of the operating arc regiment of the simulator by an amount corresponding to the reduction in relative height of the flywheel.

The preferred embodiments of FIGS. **7** to **9** provide for the majority of the mass of the flywheel **3** to be concentrated near the feet of the oarsman. This advantageously makes the frame **35** feel more like a single scull kovuto **4**. Further, the angular force on the rowing machine **1** is significantly reduced because the mass of the flywheel has been lowered and disposed more between the weight-bearing carriage wheels than substantially above them.

That is, the flywheel **3** is also moved closer to the wheels, bearings or rollers **52** supporting the frame **35**. Instead of the typical 6-8 kg weight of the flywheel **3** plus a surrounding cage (commonly used) act as a heavy counterweight raised at the end of the frame. The forces are substantially or significantly cancelled once the user's feet are placed on the foot rests **53**. It should be remembered that dynamically balanced simulators are inherently less stable than fixed seat and flywheel simulators as the seat and flywheel must move in unison.

In prior art simulators, due to angular movement of the bearings supporting the flywheel, the weight of the oarsmans feet did not practically change the angular movement of the flywheel (to which the footrest **53** is attached via frame **35**) bearings. As a result, a frame having a significantly lower weight is required to keep continuous pressure on the weight bearing rollers. In the preferred embodiment, this is only about 10 kg being a significant improvement over the prior art.

Thus there is less pressure on the counter-acting bearings supporting the flywheel thereby allowing manufacture of simulators **1** with lower tolerances on the spacing of the bearings. This advantageously also eliminates the need to have adjustable axles. Previously at end of a stroke, if the gap under the rollers **52** exceeded about 0.8 mm, a bump occurred due to the flywheel weight. This has now most advantageously been eliminated due to positioning the flywheel axle above the beam by an amount less than a flywheel radius. This also makes the rolling action of the frame **35** smoother as there is less upward pressure on the lower bearing near the user's feet.

In practice, particularly in a gymnasium or institutional environment, this also reduces the effect of dust and other foreign matter building up on the beam **31** and seat rollers **51** or flywheel frame rollers **52** and affecting the operation of the rollers.

It will further be appreciated that the carrying and handling of the frame **35** is much easier when the flywheel is mounted as shown in FIGS. **7** to **9**. The frame **35** can be shorter, and the mass of the flywheel is most preferably in the middle of the frame **35**, where the person is carrying it, rather than at the end of the frame **35** as is typical in the prior art. Of course, reducing the length of the frame **35** reduces the size of the machine **1** which is advantageous for storage and transport.

The flywheel **3**, if low enough, allows the oarsmans hands to travel over the top of it or any cage **3**A if used, which they would otherwise hit, making the simulator **1** more compact depending on the size of flywheel or cage **3**A. This is best shown in FIG. **9**. It also offers yet another advantage in practice in that the user's hands typically require at least 4 cm clearance between take-off port for chain/drive mechanism and top of flywheel **3** or cage **3**A. The embodiment of FIG. **7** provides at least this clearance allowing the user to pull from a take-off point not too artificially high.

Lastly and possibly importantly from a general consumer use perspective, the floor space required and when in use the safe operating area thereabout has been reduced by the radius of the flywheel **3** or cage **3**A. This has been allowed by the reduction of height the flywheel is mounted above the beam **31**. That is relatively significant, being of the order of 300 mm or so in the preferred embodiment. This is since the flywheel **3** is disposed at the end of or past the frame **35** by a significant fraction of the diameter of the flywheel. In the preferred embodiment this is about 270 mm over a flywheel diameter of 300 mm. In practical use, this makes a significant contribution.

The preferred embodiment of the invention of FIG. **9**, for example, also advantageously disposes the flywheel lower (and cage **3**A combination) consequently. As lowered so as not to exceed a flywheel radius above the beam(s), there is no longer an obstruction therefrom to the rower's forward field of view. Not only is this more pleasant aesthetically allowing the background to be embraced, the rower can watch the horizon, television, other background instead of the flywheel/cage combination oscillating back-and-forth dominating their vision. This last benefit has been particularly advantageous in testing as it also makes it a lot easier to synchronise with a background screen showing a crew rowing, for example. This can be a significant competitive advantage via use of the preferred embodiment of FIG. **9**. The ability of the prior art machines to allow such synchronisation with fellow rowers due to mass/inertia interaction being substantially equal allowing the better field of view definitely improves that aspect.

Although not illustrated, it will be appreciated that the energy storage device can also be formed as part of the handle. For example, the left and right hand handgrips **8** and **9** may be mounted to a handle body such that application of a force by a user causes the handgrips to elastically deform. In this way, the handgrips absorb force over the first part (20% to 80%) of a stroke and release the energy once the applied force has reduced a predetermined amount later in the stroke.

Furthermore, it will be appreciated that the energy storage device can be disposed at any preferred location from the handle(s) to the energy dissipation device and still simulate the effects of a flexing oar.

The foregoing describes only preferred embodiments of the present invention and modifications, obvious to those skilled in the art, can be made thereto without departing from the scope of the present invention.

Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a variety of alternate and/or equivalent implementations may be substituted for the specific embodiments shown and described without departing from the scope of the present invention. This application is intended to cover any adaptations or variations of the specific embodiments discussed herein. Therefore, it is intended that this invention be limited only by the claims and the equivalents thereof.

What is claimed is:

1. A rowing machine comprising:
- a longitudinally extending beam;
- a seat mounted to said beam and slidable therealong;
- a frame mounted to said beam and slidably movable therealong independently of said seat;
- a pair foot rests mounted to a user end of said frame;
- a flywheel rotatably mounted by a flywheel shaft to said frame, said flywheel shaft mounted to said frame a height less than a radius of said flywheel above said beam; and
- wherein said flywheel is drivable by a cable through a drive means mounted to said frame such that one end of said cable remote from said flywheel is connected to a handle and the other end of said cable connected to a cable take up mechanism.

2. A rowing machine according to claim **1** wherein said flywheel shaft is mounted a height above said beam of between 5% to 90% of the radius of said flywheel.

3. A rowing machine according to claim **1** wherein said cable is selected from the group consisting of twisted or braided metal wires, chain, belt, cord, or a combination of two or more thereof.

4. A rowing machine according to claim **1** wherein said drive means includes a geared sprocket wheel configured to drive said flywheel upon rotation in one direction of said sprocket, said cable including a chain portion to engage with said sprocket wheel to drive said flywheel.

5. A rowing machine according to claim **1** wherein said flywheel shaft is disposed at or adjacent a front end of said frame being distal said frame user end.

6. A rowing machine according to claim **1** comprising a pair of parallel spaced apart beams wherein each of said seat and said frame are mounted to each said beam.

7. A rowing machine according to claim **1** wherein said frame comprises a body mounted to said beam and an arm extending therefrom away from said user end of said frame and terminating at a frame front end to which said flywheel is mounted.

8. A rowing machine according to claim **1** wherein said cable take up mechanism is mounted to said frame, said take-up mechanism rewinding and maintaining a predetermined tension on said cable.

9. A rowing machine according to claim **7** wherein said cable take-up mechanism comprises a constant tension spring element, or an elastic cord and a plurality of pulleys.

10. A rowing machine according to claim **1** wherein said drive means is mounted to said frame vertically higher than the top of said flywheel or than the flywheel shaft.

11. A rowing machine according to claim **10** wherein said drive means is disposed between 4 cm and 30 cm higher than the top of said flywheel.

* * * * *

United States Patent [19]
Street

[11] **Patent Number: 4,625,962**
[45] **Date of Patent: Dec. 2, 1986**

[54] **UPPER BODY EXERCISE APPARATUS**

[75] Inventor: **Glenn M. Street**, State College, Pa.

[73] Assignee: **The Cleveland Clinic Foundation**, Cleveland, Ohio

[21] Appl. No.: **663,169**

[22] Filed: **Oct. 22, 1984**

[51] **Int. Cl.**[4] **A63B 21/22**
[52] **U.S. Cl.** **272/132**; 272/69; 272/97; 272/DIG. 6; 272/72
[58] **Field of Search** .... 272/132, 70, 72, 73, 272/69, 79, 136, DIG. 6, DIG. 5, 97; 128/25 R

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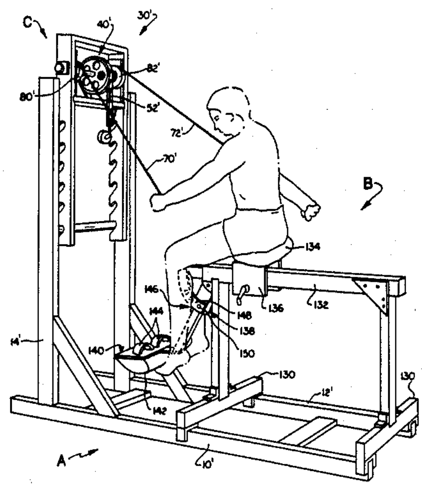
Primary Examiner—Richard J. Apley
Assistant Examiner—Robert W. Bahr
Attorney, Agent, or Firm—Fay, Sharpe, Fagan, Minnich & McKee

[57] **ABSTRACT**

A lower support frame (A) mounts a lower body support structure (B) and an upper body exercise structure (C) thereon. The upper body exercise structure includes an upper frame (**30**) which is selectively and adjustably mounted on the lower support frame. A flywheel (**40**) is rotatably mounted in the upper frame. A belt (**52**) and selectable number of weights (**62**) drag along the flywheel for selectively adjusting the effort required to maintain rotation of the flywheel. Flexible cables (**70**, **72**) are each wrapped around a pulley (**84**). A one-way clutch (**86**) selectively connects the pulley with the flywheel for providing rotational driving force thereto as the cable is pulled. A rewind spring (**92**) rewinds the cable back onto the pulley. The relative positions of the lower body support structure (B) and the upper body exercise structure (C) are selectively adjustable such that the exercise apparatus is usable in training for walking or running (FIG. **1**), ski poleing (FIG. **4**), canoeing or kayaking (FIG. **5**), rowing (FIG. **6**), and other sports.

15 Claims, 6 Drawing Figures



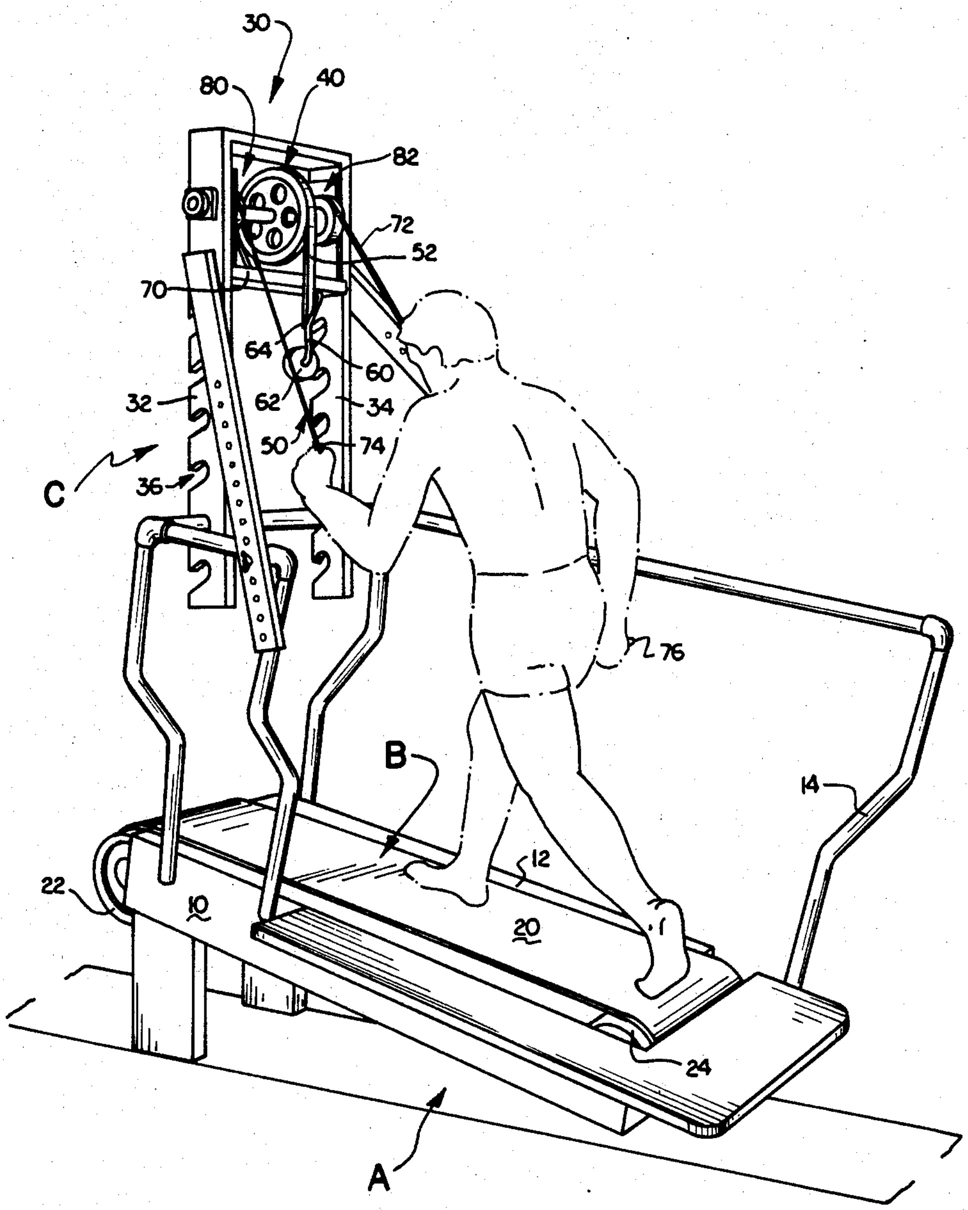


FIG. 1

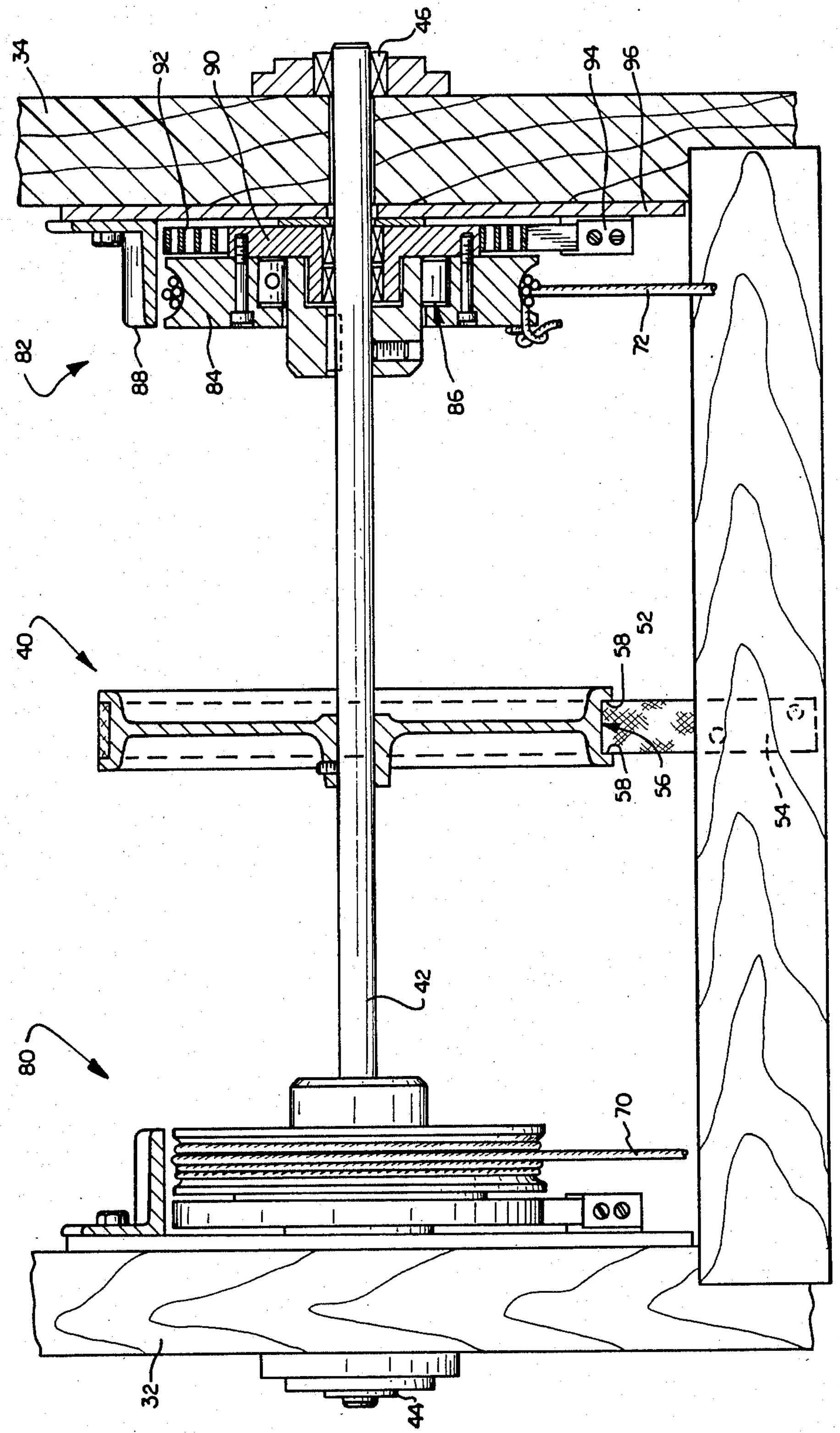
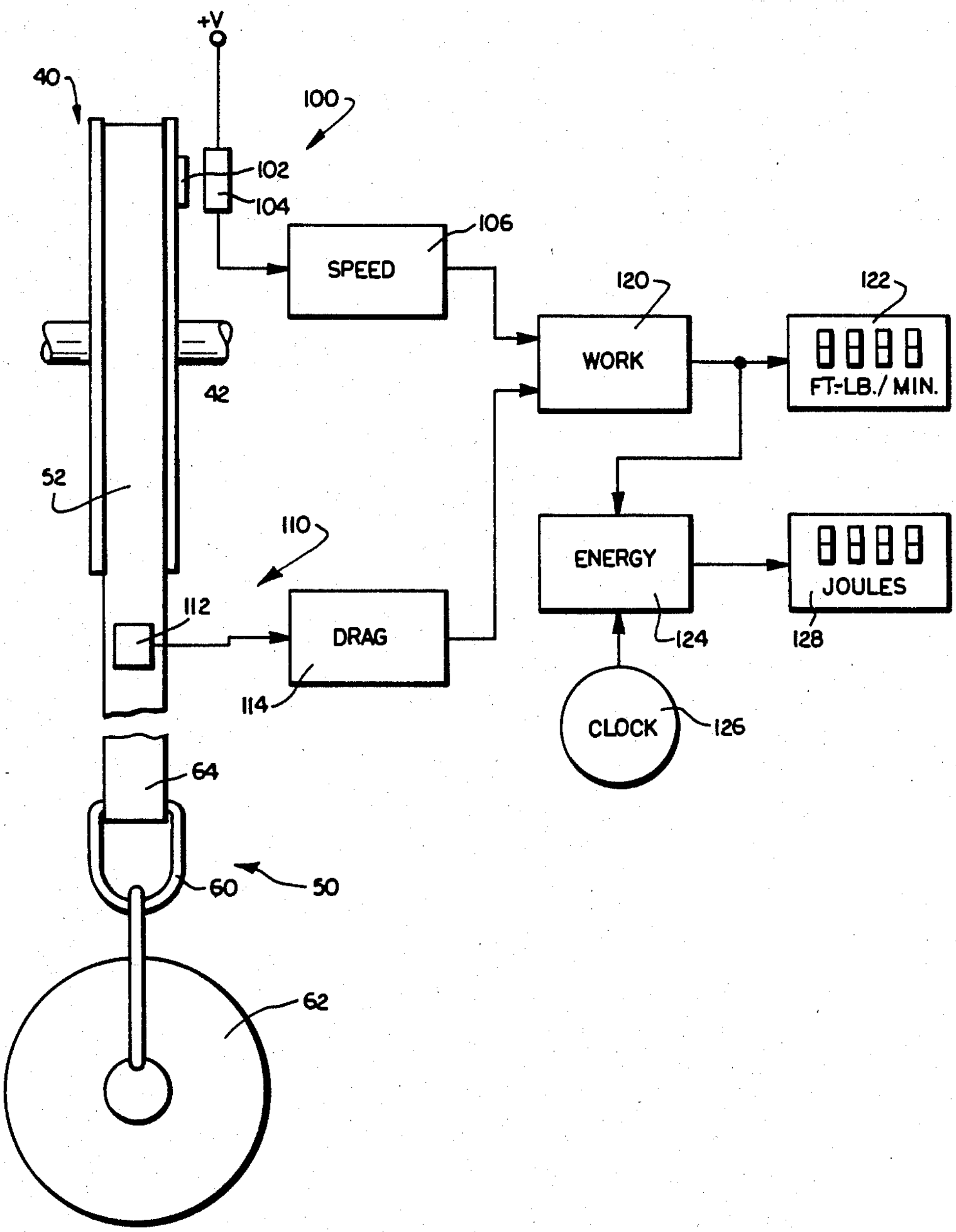


FIG. 2

FIG.3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DRAG
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CLOCK
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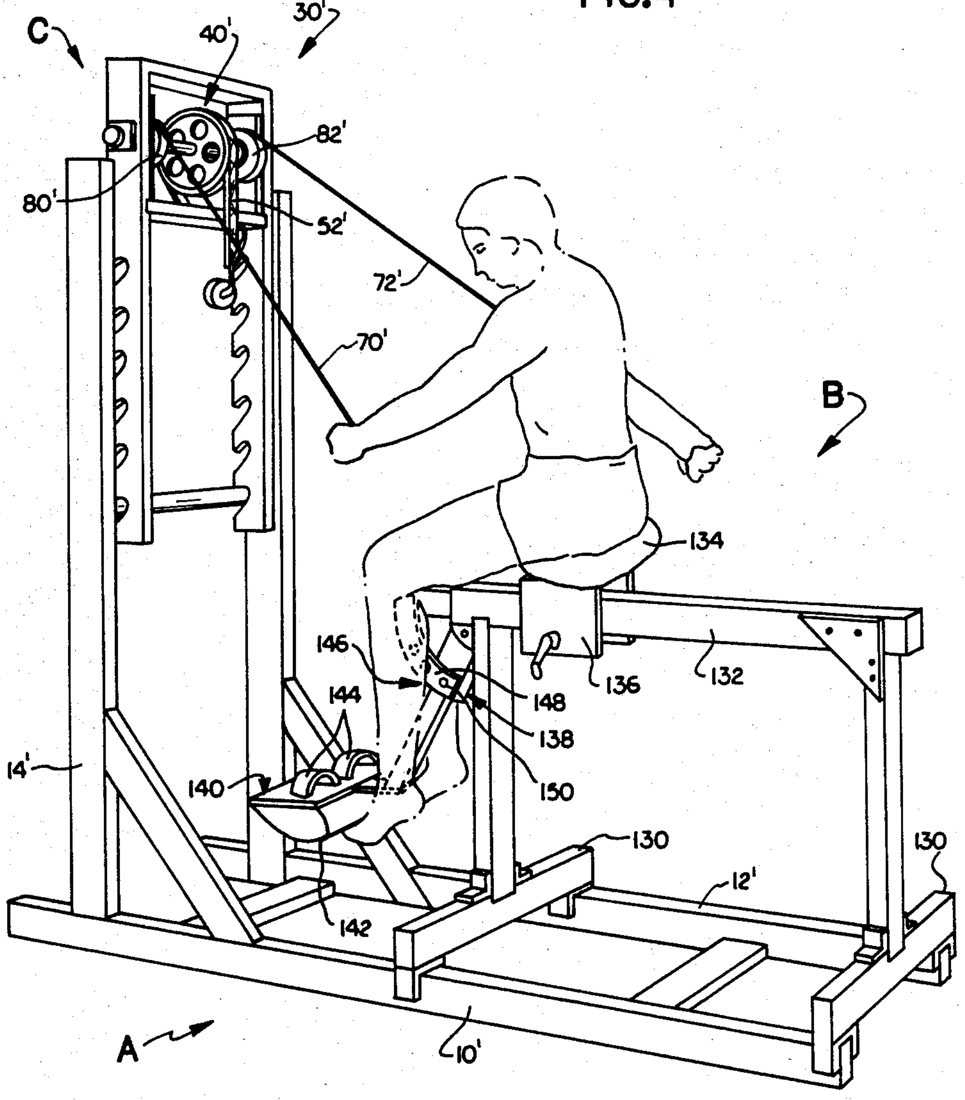
FIG.4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82'
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52'
72'
70'
B
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140
150
130
130
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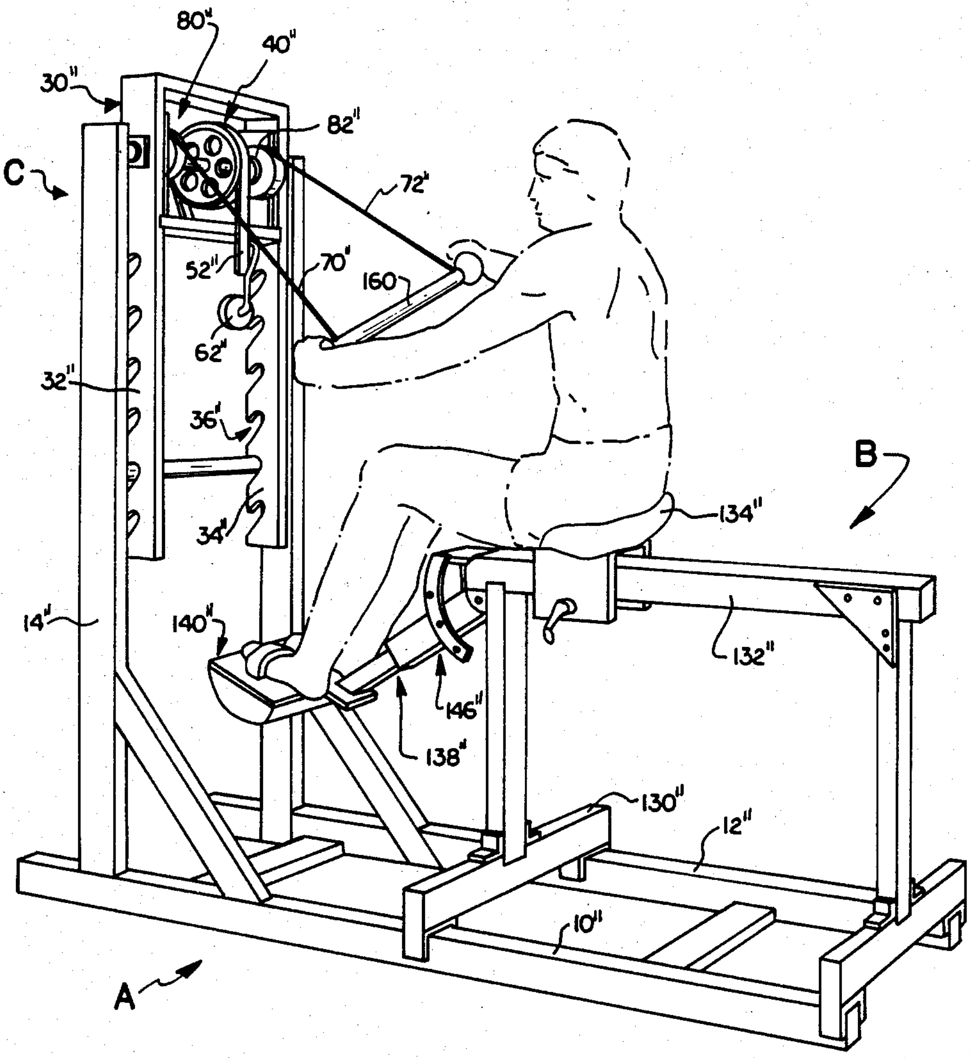
142
A
10'

FIG. 5



80"
40"
30"
82"
C
72"
52"
70"
160
62"
32"
36"
B
34"
134"
14"
140"
132"
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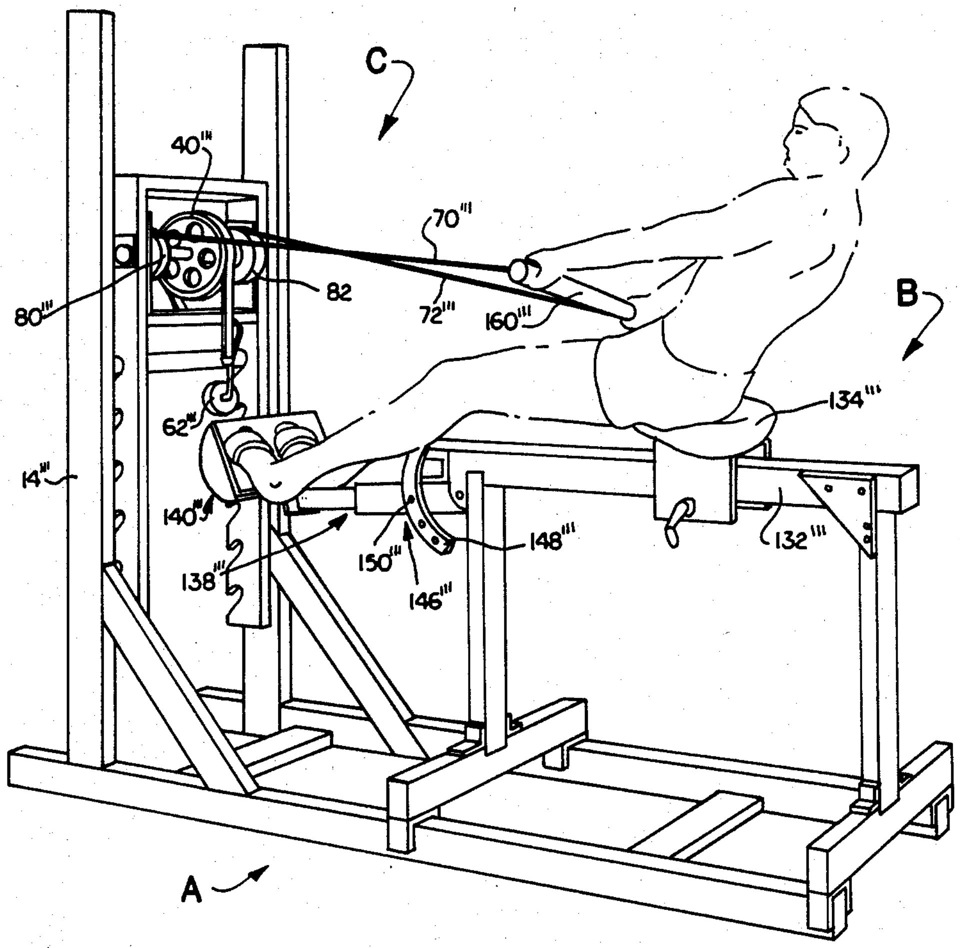
12"
10"
A

FIG. 6



UPPER BODY EXERCISE APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to the art of physical fitness apparatus. It finds particular application in conjunction with upper body exercise apparatus to train for cross-country skiing, canoeing, rowing, and the like. Although the invention is described in conjunction with upper body training for these sports, it is to be appreciated that the invention is also applicable to other conditioning, exercise, and body-building applications.

Heretofore, various exercise apparatus have been devised for both the upper and lower body. In one type of apparatus, the athlete pulls on handles which are attached to ropes or cables. In some of the prior art apparatus, the ropes or cables are connected to weights. In others, the ropes or cables are interconnected such that the one arm is pulling against the other. In another type of apparatus, the athlete works to maintain rotation of a flywheel. A friction brake controls the amount of effort required to maintain flywheel rotation.

Although these prior art exercise systems have found acceptance, each has its drawbacks. One drawback shared by many prior art exercise systems is that only the upper or lower body is exercised. Even those systems which exercise both the upper and lower body frequently fail to balance the upper and lower body exercise in a manner appropriate to the sport for which the athlete is training. This lack of balance detracts from the athlete's overall training program and tends to inhibit the development of muscle tone and coordination.

The present invention contemplates a new and improved exercise apparatus which is ideally suited to provide upper body exercise in proper balance and coordination with lower body exercise for a variety of sports.

SUMMARY OF THE INVENTION

In accordance with the present invention, an exercise apparatus is provided. A flywheel is rotatably mounted on a frame and an adjustable drag means is provided for selectively adjusting the effort required to maintain rotation of the flywheel. Flexible cables extend from handles to a drive means for selectively rotating the flywheel. In this manner, pulling of the handles with effort as determined by the adjustable drag means causes the drive means to rotate the flywheel.

In accordance with another aspect of the present invention, the frame is selectively mounted on a lower support frame which includes means for simultaneously exercising the athlete's lower body portion.

In accordance with another more limited aspect of the invention, the drive means includes a one-way clutch which is interconnected with each cable. A rewind spring is connected with the one-way clutch for rewinding the cables between each pull. In this manner, the athlete pulls the cable with an amount of effort as determined by the adjustable drag means and selectively limits the rate of return of the cable with an amount of force as determined by the rewind spring.

One advantage of the present invention is that it enables the athlete to exercise upper and lower body muscles simultaneously in a balanced relationship.

Another advantage of the present invention is that it facilitates the development of overall body tone and coordination.

Yet another advantage of the present invention is that it is readily adaptable for use in conjunction with a variety of upper body training programs.

Still further advantages of the present invention will become apparent upon reading and understanding the following detailed description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may take form in various parts and arrangements of parts. The drawings are only for purposes of illustrating a preferred embodiment and are not to be construed as limiting the invention.

FIG. **1** is a perspective view of the present invention in combination with a treadmill for coordinated exercising of the upper and lower body in a manner which is ideally suited for training for running or jogging;

FIG. **2** is a front sectional view of the flywheel and one-way drive assembly of FIG. **1**;

FIG. **3** is a schematic diagram of a system for monitoring exercise rate and total energy expended;

FIG. **4** illustrates an exercise apparatus in accordance with the present invention which is ideally arranged for developing the muscles used in ski poleing;

FIG. **5** illustrates an arrangement of the present invention which is ideally suited to training for canoeing or kayaking; and,

FIG. **6** illustrates another embodiment of the present invention which is ideally suited to training for rowing.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to FIG. **1**, the exercise apparatus includes a lower support frame portion A which rests on the floor or other supporting surface. A lower body support structure B is mounted on the lower support frame to support the athlete thereon, particularly, the lower body portion of the athlete. An upper body exercise structure C is selectively connected with the lower frame to be supported thereby in an appropriate position for the athlete to exercise upper body muscles.

The lower support frame includes side rails or structures **10**, **12**, from which an upstanding frame portion or hand rail **14** extends. The lower body support structure B includes a treadmill mounted on the lower support frame. The treadmill includes an endless belt **20** which is rotatably mounted on a pair of rollers **22**, **24**. An adjustable friction brake, not shown, selectively adjusts the amount of resistance to movement of the belt **20**.

The upper body exercise structure C includes a frame **30** having vertically mounted side pieces **32** and **34**. The side frame members **32**, **34** include adjustable mounting means, such as angled U-shaped recesses **36**, for selectively and adjustably mounting the upper body exercise structure C on the upstanding portion **14** of the lower support frame A.

With continuing reference to FIG. **1** and further reference to FIG. **2**, a flywheel **40** is rotatably mounted in the upper frame **30**. More particularly to the preferred embodiment, the flywheel is fixedly mounted on a rotating shaft **42** which is connected with bearings **44**, **46** mounted on the frame side members **32**, **34**, respectively.

An adjustable drag means **50** selectively adjusts the effort required to maintain rotation of the flywheel **40**. The adjustable drag means includes a belt **52** which is mounted at one end **54** to the upper frame **30**. The belt extends through a channel in the flywheel **40** defined by a bottom surface 56 and side walls 58. A hook or similar mounting means 60 enables weights 62 of various sizes to be connected on an opposite end 64 of the belt. By selectively adjusting the amount of weight hung on the second end of the belt, the amount of frictional drag applied by the belt 52 to the flywheel 40 is adjusted. In this manner, the amount of effort which the athlete must expend to maintain the flywheel rotating is selectively adjustable.

A pair of ropes or cables 70, 72 extend between handles 74, 76, respectively, at one end. The other ends of the cables are connected with drive means 80, 82 for selectively converting the force exerted by the athlete in pulling on the cables into rotation driving force for the flywheel 40.

With particular reference to FIG. 2, because both drive means are of analogous construction, drive means 82 will be described in detail and it is to be appreciated that the description applies by analogy to drive means 80. In the preferred embodiment, the drive means is a one-way friction clutch. However, ratchet and other drives which convert the back and forth movement of the cables to rotation of the shaft are contemplated. A pulley 84 having a rope or cable receiving recess around the outer periphery thereof is connected with a one-way frictional engagement assembly 86. The one-way assembly interconnects the pulley and the shaft 42 as the pulley rotates in a first direction relative to the shaft and allows sliding motion therebetween as the pulley rotates in the opposite direction. A cable guard 88 is mounted on the frame and extends closely adjacent the outer peripheral recess in the pulley 84 to prevent the cable or rope from jumping from the peripheral pulley recess.

A spring holder 90 is operatively connected with the pulley 84 for rotational movement therewith. A coil spring 92 spirals radially outward from the spring holder 90. One end of the spring is connected with the spring holder 90 and the other end is mounted in a spring holding block 94 which is interconnected with the upper frame 30. A metal protection plate 96 is mounted between the coil spring 92 and the frame assembly 30 for preventing the spring from engaging and damaging the frame side portions.

In operation, each time the athlete pulls one of the cables, the corresponding pulley rotates in the first direction which causes the one-way clutch assembly to engage the shaft 42 for rotation therewith. The athlete continues pulling the cable with sufficient effort to overcome the resistance provided by the coil spring, the resistance provided by the frictional drag means 50, and the inertia of the flywheel 40. Thereafter, the athlete controlledly allows the coil spring to rotate the pulley in the opposite direction such that the cable is retracted into the peripheral groove therearound. By cyclically pulling and retracting the cables, the flywheel is caused to maintain a generally constant angular velocity or speed.

With reference to FIG. 3, an electronic display provides the athlete with a ready reference of the rate at which he is exercising and the total amount of effort that he has expended since the beginning of the exercise session. The circuit includes a tachometer means 100 for determining the angular velocity or speed at which the flywheel is rotating. In one embodiment, the speed determining means includes a magnet 102 mounted on the flywheel and a reed switch 104 which closes each time the magnet passes. A speed circuit 106 converts the rate at which pulses are received from the reed switch into a signal which varies in proportion to the speed or angular velocity of the flywheel. A frictional drag means 110 determines the resistance to rotation applied by the drag means 50. A strain gauge 112 is mounted on the belt 52 to provide an electronic reading indicative of the frictional drag. The drag is proportional to the amount of weight hung on the belt and various system constants, such as the coefficient of friction between the flywheel and the belt. Optionally, other structures for determining the drag or the amount of weight hung on the hook 60 may be used. For example, a keypad may be provided so that the athlete may enter the amount of weight. A drag circuit 114 derives an indication of the drag or resistance which must be overcome to maintain rotation of the flywheel.

A work circuit 120 determines the amount of work or effort which is instantaneously being expended by the athlete to rotate the flywheel at the determined speed while overcoming the determined drag. A work display 122 provides and LED or other man-readable display of the amount of work which the athlete is currently performing. The work may be displayed in various units such as foot-pounds per minute.

An integrating circuit 124 in coordination with a clock 126 integrates the instantaneous amount of work to determine the total amount of energy expended since the beginning of the exercise period. An energy display means 128 provides a visual display of the total energy expended. The total energy expended may be expressed in any suitable unit, such as foot-pounds, calories, or joules. Optionally, a recorder may make a record at regular intervals of the work being expended and the total energy expended since the beginning of the session.

In the alternate embodiment of FIG. 4, the exercise apparatus is configured to train for cross-country skiing and other activities that require poleing and the like. In the embodiment of FIG. 4, like elements with the embodiment of FIG. 1 are denoted by the same reference numerals but followed by a prime ('). The lower support frame A includes horizontal supporting rails 10' and 12' which are interconnected with an upstanding frame portion 14'.

The lower body support structure B includes frame portions 130 which are selectively mounted with the lower support frame side rails 10' and 12'. A longitudinally extending rail 132 selectively receives an athlete supporting seat 134 thereon. A seat position adjusting means 136 enables the seat to be selectively positioned along the rail 132 and locked in the selected position. A telescopically adjustable member 138 extends from the longitudinal rail 132 to a foot supporting structure 140. The foot supporting structure includes a rounded portion or surface 142 under which the athlete may lock his feet and ankles. On an opposite surface, a pair of foot receiving loops or stirrups 144 are provided. An angular adjustment mechanism 146 enables the angle of the telescopic member 138 to be selectively adjusted. In the preferred embodiment, the angular adjustment mechanism includes a pair of arcuate members 148 disposed on opposite sides of the telescopic member having an array of aligned apertures extending therethrough. A pin 150 selectively extends through the aligned apertures and a corresponding aperture in the telescopic member 138 for selectively adjusting the angular position thereof. In this manner, the position and orientation of the foot supporting structure is selectively adjustable.

The upper body exercise structure C includes a frame portion **30′** which is selectively mounted to the lower frame upstanding portion **14′** at any of a plurality of heights. A flywheel **40′**, over which a drag belt **52′** is positioned, is selectively rotated as the athlete alternately or simultaneously pulls cables **70′**, **72′**, to cause drive means **80′**, **82′** to rotate the flywheel.

As arranged in FIG. **4**, the drive means **80′** and **82′** are positioned above the athlete such that he is pushing downward and rearward as the cables are pulled. The seat **134** and foot support **140** are disposed such that the athlete's knees are bent and his body is inhibited against being lifted upward. This enables the athlete to develop and tone the muscles used for pushing on ski poles during cross-country skiing.

In the embodiment of FIG. **5**, like elements with the embodiment of FIG. **4** are denoted by the same reference numerals but followed by a double prime (″). To enable the athlete to develop muscles used for canoeing or kayaking, cables **70″** and **72″** extend from opposite ends of a handle portion **160**. As illustrated, the handle **160** has enlarged portions at either end analogous to the upper end of a canoe paddle such that the athlete may paddle to either side to develop both arms. Optionally, the handle **160** may be a regular canoe paddle. As yet another option, the handle **160** may be a double-sided paddle as used in kayaking. The stroking or paddling movement of the handle **160** pulls the cables **70″** and **72″** to cause one-way friction drive means **80″** and **82″** to maintain rotation of a flywheel **40″**. The upper frame assembly **30″** is mounted lower relative to the lower frame upstanding portion **14″** such that the component of motion exerted by the athlete is more nearly rearward and less downward than in the embodiment of FIG. **4**. That is, the height of the one-way friction drive means is adjusted such that the effort exerted in pulling the cables is in a direction appropriate to the sport. A seat **134″** of the lower body supporting structure B and the position of a foot supporting means **140″** are selected to be in a position roughly corresponding to the position in canoeing or kayaking. It should be noted, that the athlete need not be at the same angular orientation relative to horizontal as in a canoe or kayak. Rather, the athlete may be rotated from the normal canoeing or kayaking position and the height of the upper frame portion **30″** may be adjusted correspondingly such that the paddling motion is in the proper direction relative to the athlete.

In FIG. **6**, like elements with the embodiments of FIGS. **4** and **5** are denoted with the same reference numerals but followed by a triple prime (‴). A foot support **140‴** is positioned generally straight in front of the athlete by an angular adjustment means **146‴**. A seat **134‴** is positioned rearward on a rail **132‴** such that the athlete's legs are relatively straight. Optionally, slide means may be provided for enabling the seat **134‴** to slide relative to the rail **132‴**. The upper body exercise structure C is mounted relatively low on the lower support frame A such that as the athlete pulls on a handle **160‴** cables **70‴** and **72‴** are pulled generally horizontally. The cables are connected with drive means **80‴** and **82‴** for maintaining a flywheel **40‴** rotating at a substantially constant speed. The athlete must put sufficient energy into the flywheel to compensate for the energy lost by the drag applied by drag strap **52‴** and weight **62‴**.

The invention has been described with reference to the preferred embodiments. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding specification. It is intended that the invention be construed as including all such alterations and modifications insofar as they come within the scope of the appended claims or the equivalents thereof.

Having thus described preferred embodiments of the invention, the invention is now claimed to be:

1. An exercise apparatus comprising:

(a) a lower support frame including an upstanding frame portion extending upward to at least about the height of an athlete's waist;

(b) a lower body support structure operatively connected with the lower support frame, the lower body support structure including:

(i) a lower support assembly supported on the lower support frame;

(ii) a longitudinally extending rail mounted horizontally on the lower support assembly and extending parallel to a floor on which the exercise apparatus is disposed;

(iii) an athlete supporting seat mounted to the support rail to be selectively and fixedly positioned therealong;

(iv) a telescopic member pivotally connected at one end with the longitudinally extending rail;

(v) a foot supporting structure connected with an other end of the telescopic member such that telescopic member adjusts a distance between the foot supporting structure and the longitudinally extending rail;

(vi) an angular adjustment mechanism for selectively fixing a relative angular relationship between the telescopic member and the longitudinally extending rail;

(c) an upper frame;

(d) a flywheel rotatably mounted adjacent a top of the upper frame;

(e) an adjustable drag means for selectively adjusting the effort required to maintain rotation of the flywheel;

(f) a drive means for selectively rotating the flywheel, the drive means being mounted contiguous to the flywheel;

(g) an adjustable mounting means for selectively mounting the upper frame to the lower support frame such that the flywheel and drive means are adjustably mounted above the athlete's head;

(h) flexible cables extending downward from the drive means to at least one handle such that pulling the cables downward and rearward with effort as determined by the adjustable drag means causes the drive means to rotate the flywheel.

2. The exercise structure as set forth in claim **1** wherein the lower body support structure includes exercise means for exercising the lower body in conjunction with exercise of the upper body.

3. The exercise apparatus as set forth in claim **1** wherein the drive means includes a first pulley about which a first of the flexible cables is wrapped and a second pulley about which a second of the flexible cables is wrapped, a first one-way clutch which is connected between the first pulley and the flywheel, and a second one-way clutch which is operatively connected between the second pulley and the flywheel, and wherein the handle is an elongated member connected with the first and second cables such that an athlete can move the elongated member in a manner analogous to rowing, canoeing, or kyacking.

4. The exercise apparatus as set forth in claim **1** further including an angular velocity measuring means for measuring the speed with which the flywheel is currently rotating, a work calculating means for calculating the current amount of work being expended from the measured flywheel speed and an indication of the amount of drag applied by the adjustable drag means.

5. The exercise apparatus as set forth in claim **4** further including an energy calculating means for calculating the total amount of energy expended since the beginning of an exercise session from the calculated current amounts of work and a display means for displaying an indication of at least one of the calculated amount of work and energy.

6. An exercise apparatus comprising:

(a) a lower support frame including:
  (i) a pair of parallel lower support rails;
  (ii) an upstanding frame portion extending upward from the lower support rails;
(b) a lower body support structure including:
  (i) lower supports movably supported on the lower support rails to be selectively and fixedly positional therealong;
  (ii) a longitudinally extending rail mounted above the lower supports and extending parallel to the lower support rails;
  (iii) an athlete supporting seat mounted to the support rail to be selectively fixedly positioned therealong;
  (iv) a telescopic member pivotally connected at one end with the longitudinally extending rail;
  (v) a foot supporting structure connected with an other end of the telescopic member such that telescopic adjustment of the telescopic member adjusts a distance between the foot supporting structure and the longitudinally extending rail;
  (vi) an angular adjustment mechanism for selectively fixing a relative angular relationship between the telescopic member and the longitudinally extending rail;
(c) an upper body exercise structure including:
  (i) an upper frame selectively mounted on the lower support frame upstanding portion;
  (ii) a flywheel rotatably mounted on the upper frame,
  (iii) an adjustable drag means for selectively adjusting the effort required to maintain rotation of the flywheel;
  (iv) a drive means for selectively rotating the flywheel;
  (v) flexible cables extending from the drive means to at least one handle such that pulling the cables with effort as determined by the adjustable drag means causes the drive means to rotate the flywheel.

7. The exercise apparatus as set forth in claim **6** wherein the lower support frame includes an upper extending portion and wherein the upper frame includes a plurality of generally U-shaped recesses for selectively engaging the lower frame upper extending portion in any one of a plurality of height relationships, whereby the height of the upper body exercise structure and the relative angle at which the cables are pulled is selectively adjustable.

8. The exercise apparatus as set forth in claim **6** wherein the foot support structure includes a rounded surface for selectively receiving the athlete's feet thereunder and foot receiving loops on an opposite surface thereof.

9. The exercise apparatus as set forth in claim **6** wherein the angular adjustment mechanism includes at least one arcuate member which extends from the longitudinally extending rail, the arcuate member having a plurality of apertures therein and the telescopic member having at least one aperture which is selectively positioned in alignment with one of the arcuate member apertures as the telescopic member is pivoted, and a pin means for selective insertion through aligned arcuate member and telescopic member apertures.

10. The exercise apparatus as set forth in claim **6** further including:

an angular velocity measuring means for measuring the speed with which the flywheel is rotating and generating a speed signal indicative of the measured speed;
a drag signal means for generating a drag signal indicative of the amount of drag applied by the adjustable drag means;
a work calculating means for calculating the current amount of work being expended from the speed signal and the drag signal; and,
a display means for displaying the current calculated amount of work being expended.

11. The exercise apparatus as set forth in claim **10** further including a rewind spring operatively connected with the pulley for rewinding the cable thereonto.

12. The exercise apparatus as set forth in claim **11** wherein the rewind spring is a spiral coil spring having one end operatively connected with the pulley and the other end operatively connected with the frame.

13. The exercise apparatus as set forth in claim **12** further including a protection plate disposed between the frame and the spring for preventing injurious interaction therebetween.

14. The exercise apparatus as set forth in claim **10** wherein the pulley has a peripheral groove for receiving the cable therein and further including cable restraining means extending from the frame closely adjacent the periphery of the pulley to prevent the cable from jumping from the peripheral groove.

15. The exercise apparatus as set forth in claim **10** wherein the adjustable drag means includes a belt extending along a peripheral portion of the flywheel and at least one weight selectively hung thereon such that the amount of drag is selectively adjusted by adjusting the amount of weight hung on the belt.

* * * * *

United States Patent [19]
Duke

[11] Patent Number: 4,884,800
[45] Date of Patent: Dec. 5, 1989

[54] ROWING MACHINE

[76] Inventor: John H. Duke, 19 Cold Spring St., Providence, R.I. 92906

[21] Appl. No.: 348,782

[22] Filed: May 8, 1989

Related U.S. Application Data

[63] Continuation of Ser. No. 49,616, May 13, 1987, Pat. No. 4,846,460.

[30] Foreign Application Priority Data

Nov. 17, 1988 [WO] PCT Int'l Appl. WO88/08735

[51] Int. Cl.[4] A63B 69/06
[52] U.S. Cl. 272/72; 272/130
[58] Field of Search 272/72, 130, 71, 116, 272/134

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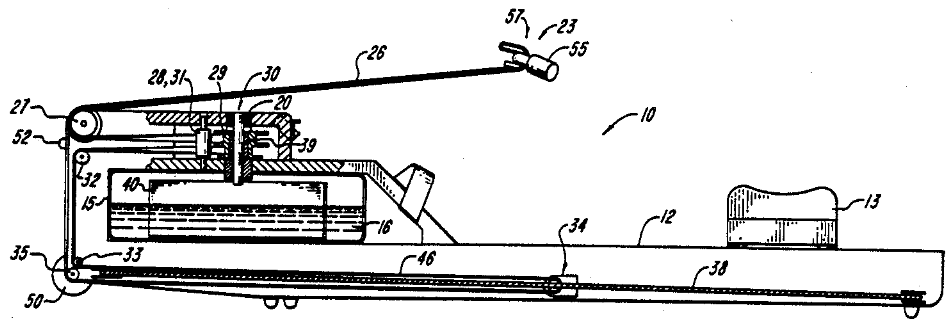
Primary Examiner—Richard J. Apley
Assistant Examiner—Franklin L. Gubernick
Attorney, Agent, or Firm—Wolf, Greenfield & Sacks

[57] ABSTRACT

A compact portable rowing machine features a hollow container that holds a supply of water. Pulling on a drive cord during a pulling segment of a stroke rotates a paddle or like mechanism located within the container to rotate the water to produce a momentum effect. Turbulence in the water provides fluid resistance to the rotation of the paddle. A drive cord is wrapped on a double spool mounted on a clutch to drive the paddle in one direction. The wrapping is such that changing the length of the drive cord between the spool and a handle gripped by a user changes the radius at which tangential force is applied by the cord to the spool to vary the resistance of the machine. In one form the drive cord also forms a portion of the recoil mechanism as a continuous closed loop strap secured at its ends to different spools of a double spool. A continuous portion of the drive cord located between the handle and one spool is to secured to the handle. The handle is constructed so that in a normal operating orientation its position on the strap is fixed, but in an unlocked orientation it may be be moved any degree to increase or decrease the resistance of the machine.

3 Claims, 8 Drawing Sheets



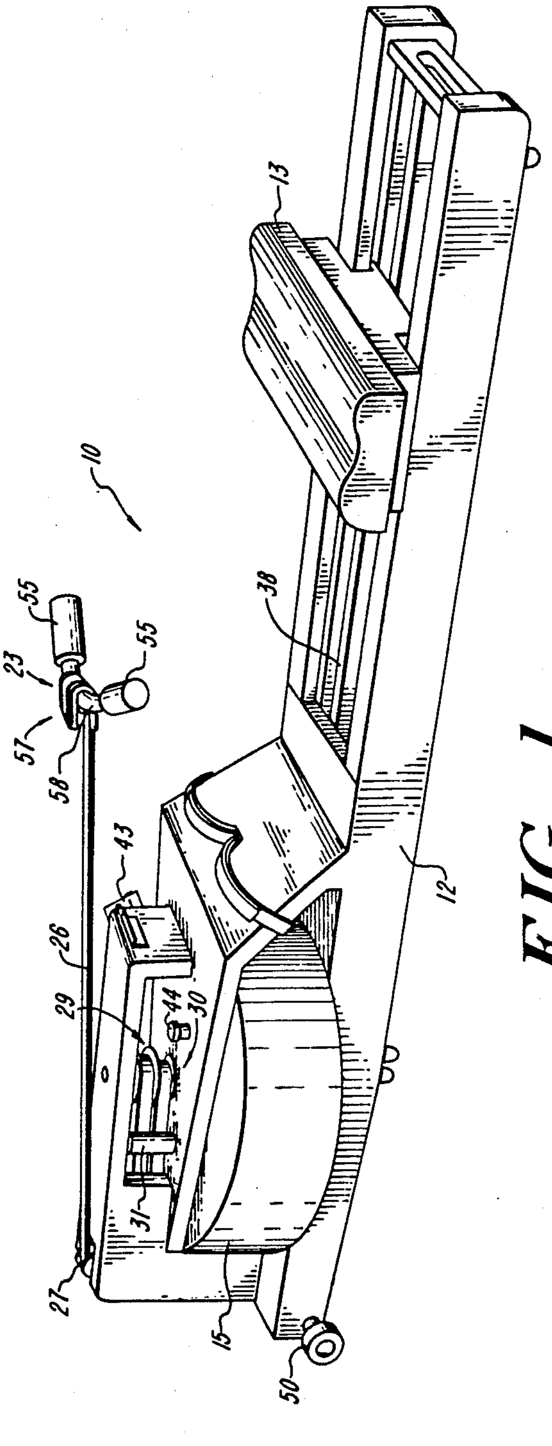


FIG. 1

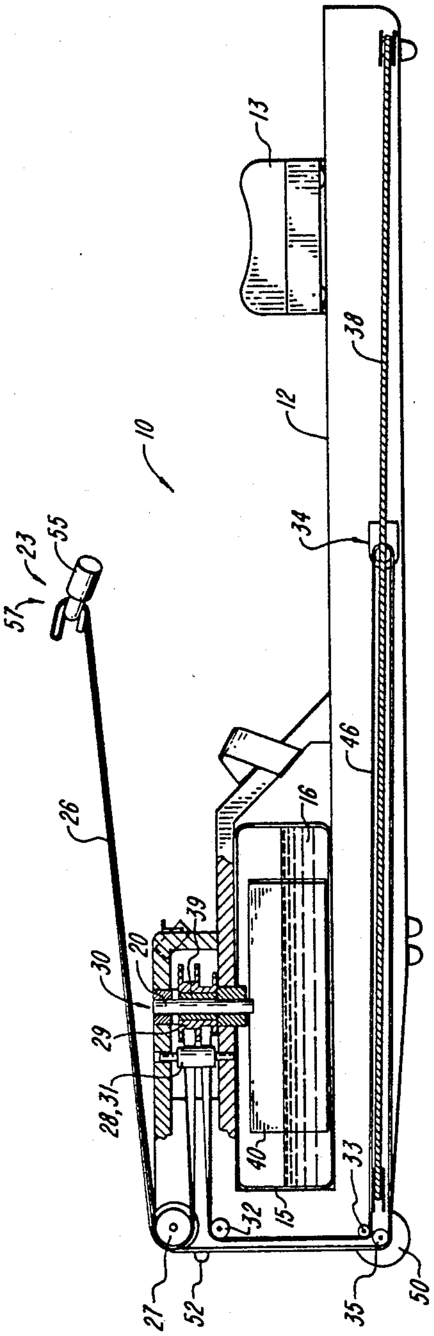


FIG. 2

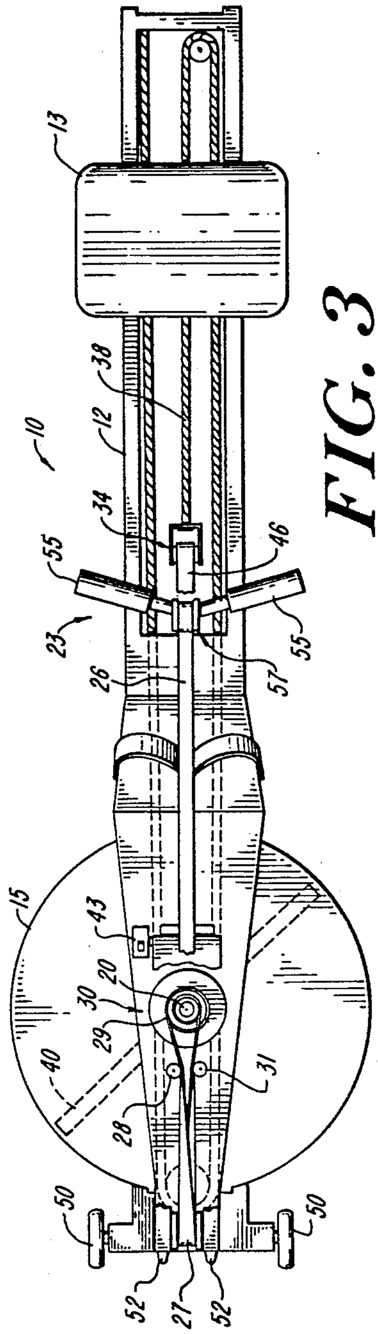


FIG. 3

APPENDIX GG

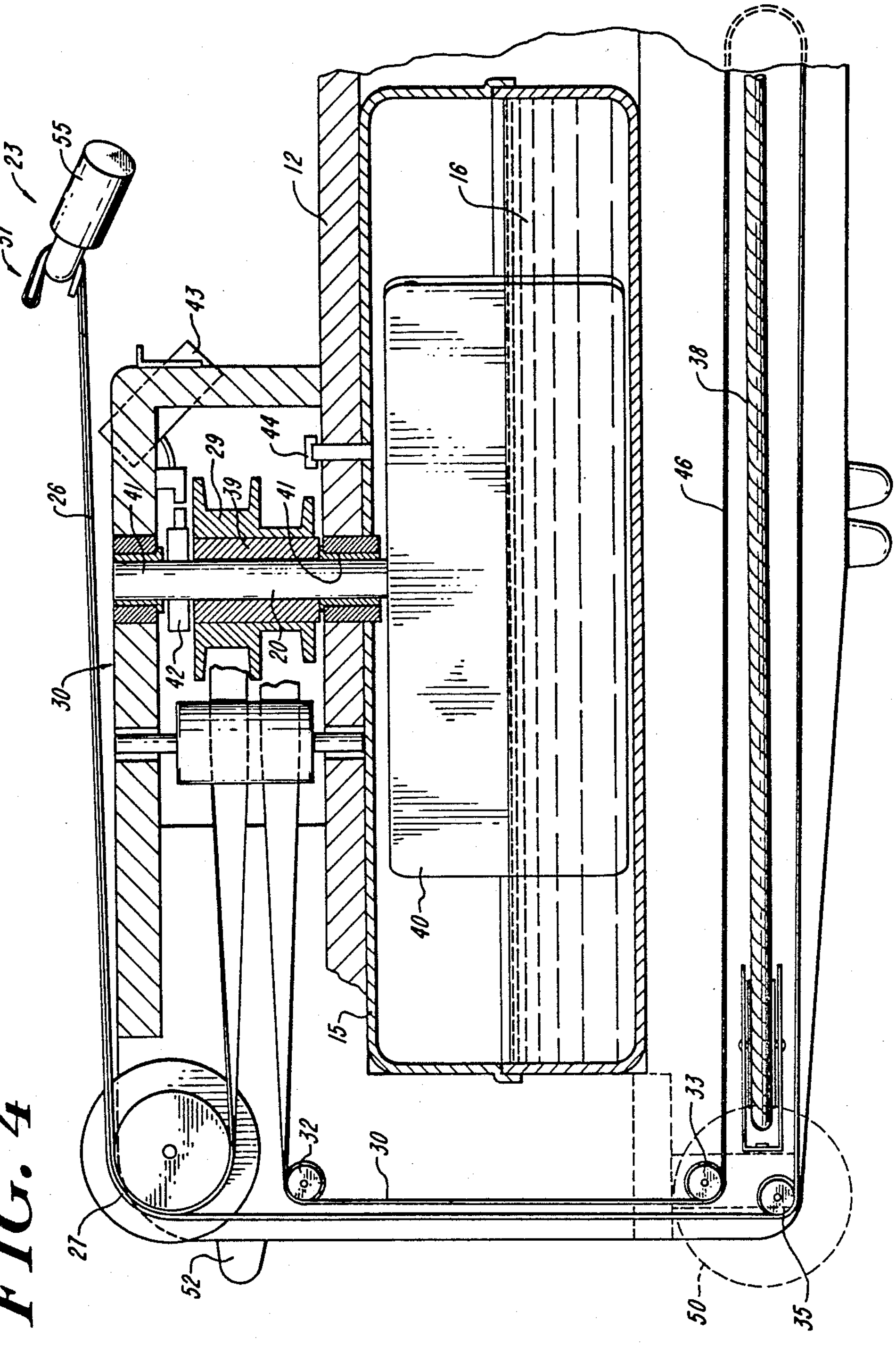


FIG. 4

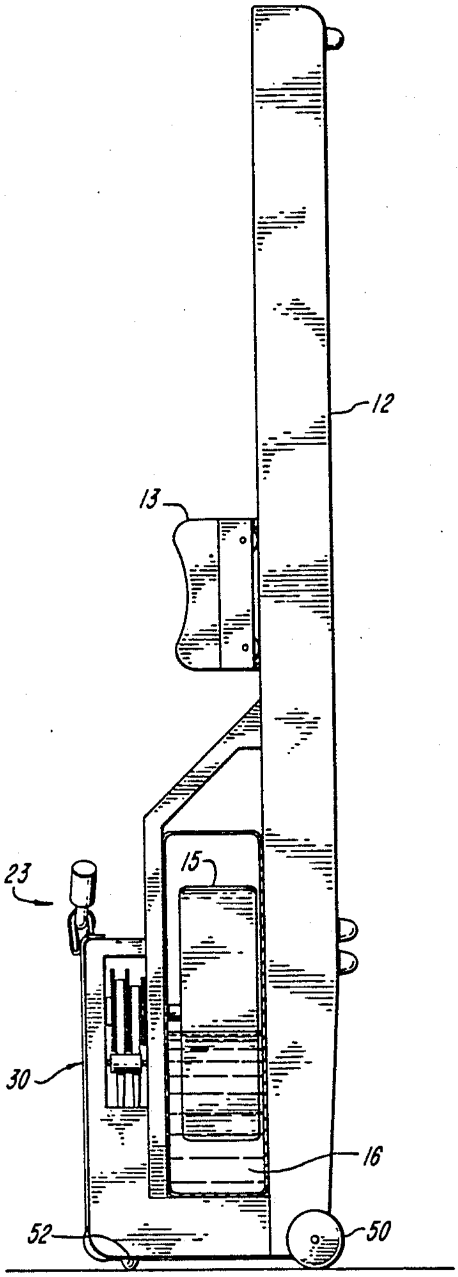


FIG. 5

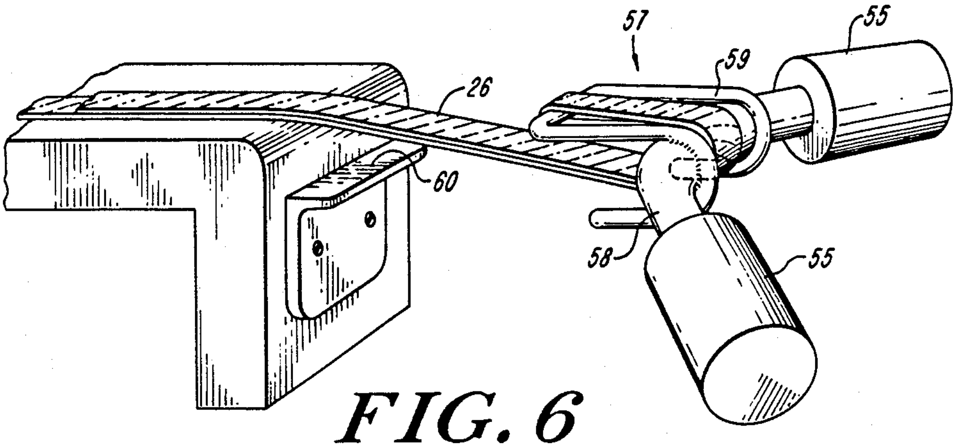


FIG. 6

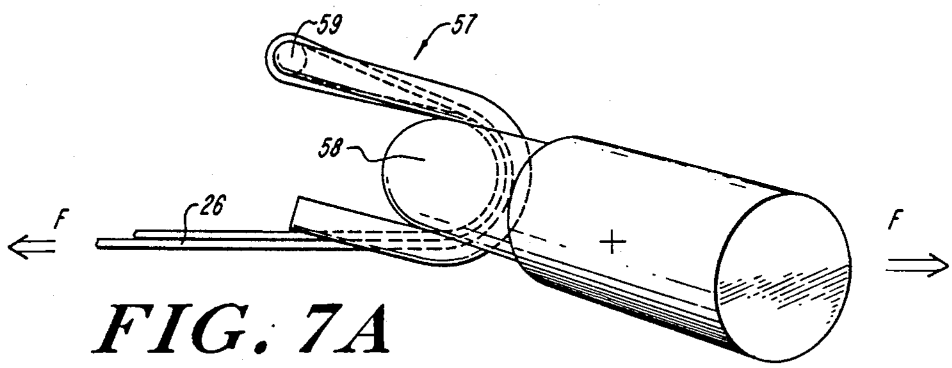


FIG. 7A

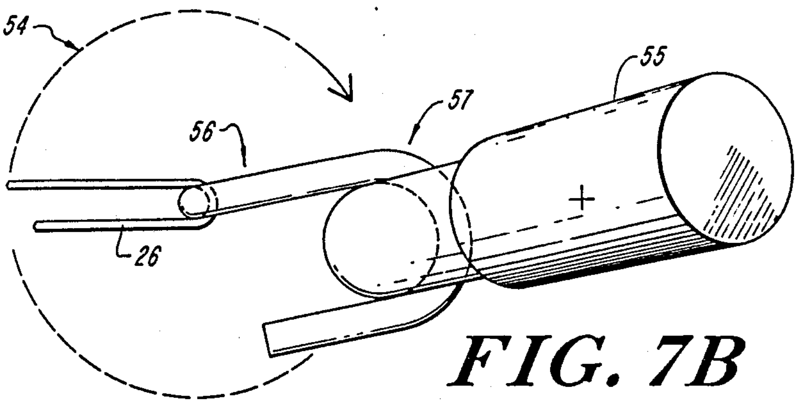
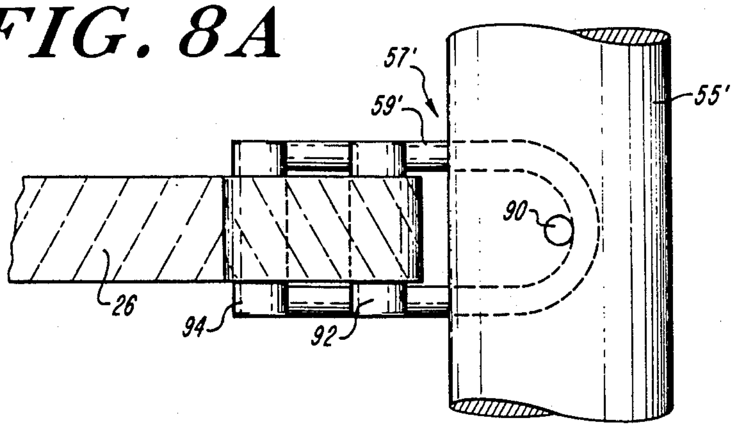


FIG. 7B

FIG. 8A



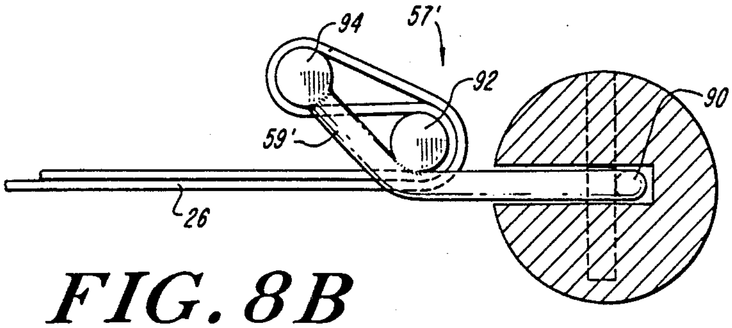


FIG. 8B

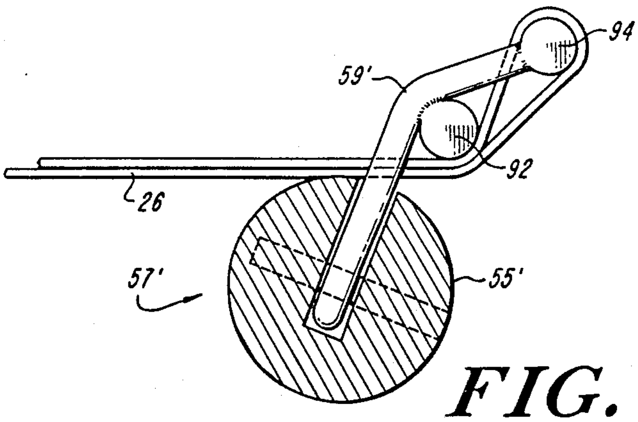


FIG. 8C

APPENDIX GG

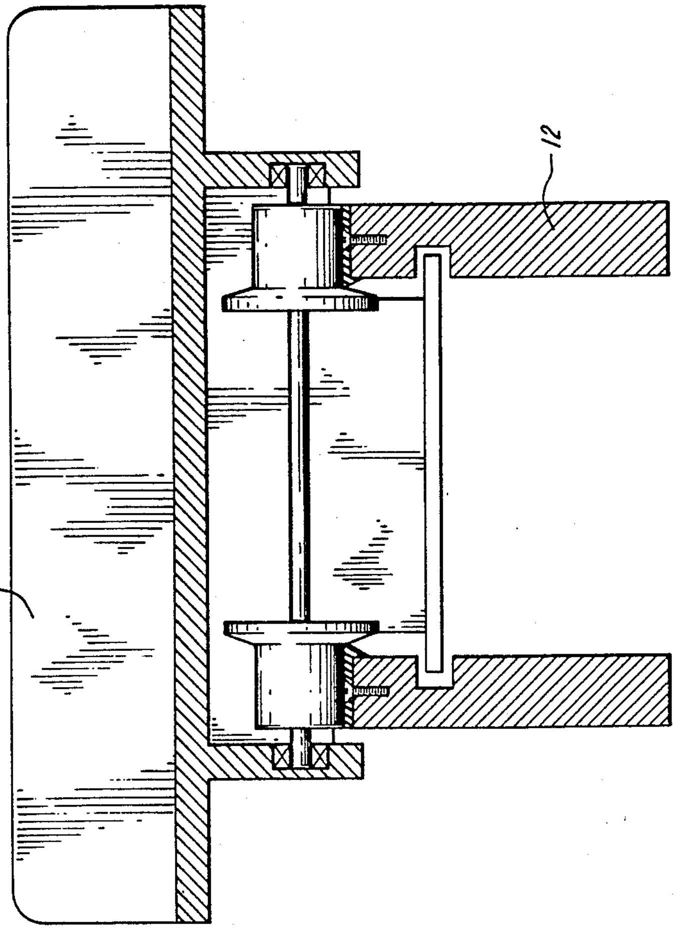


FIG. 9

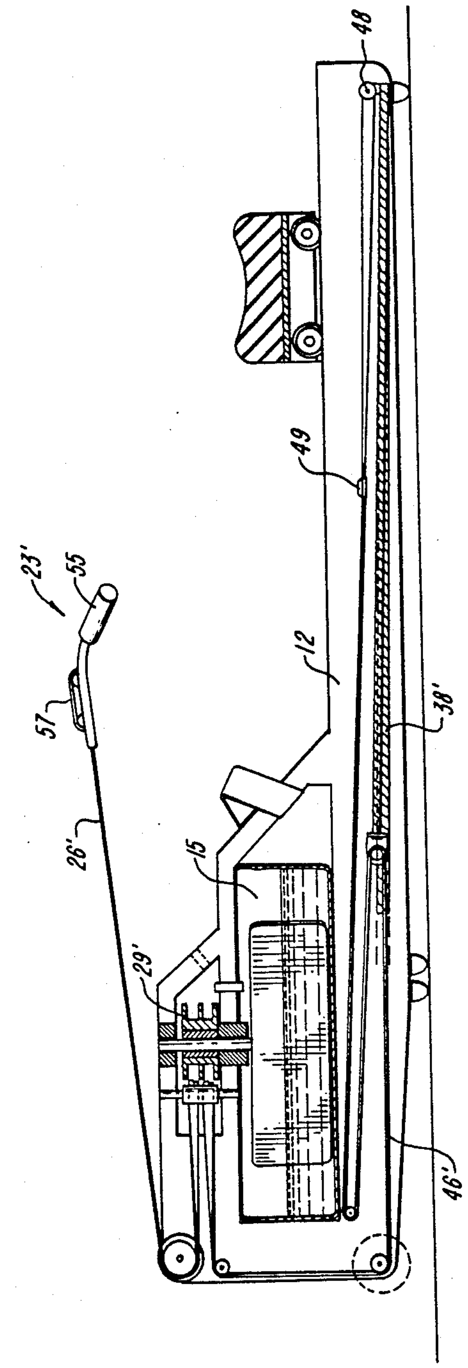


FIG. 10

ROWING MACHINE

This application is a continuation, of U.S. patent application Ser. No. 049,616, filed May 13, 1987, now U.S. Pat. No. 4,846,460.

BACKGROUND OF THE INVENTION

This invention relates in general to exercise equipment. More specifically, it relates to a portable rowing machine which provides a momentum effect to simulate closely the sensation of actually rowing and also simulates the sound of actually rowing.

Presently available rowing exercise machines either have an ability to store energy between the strokes, or they do not. This ability, commonly termed the momentum effect, is valuable for a variety of reasons. Exercise devices in the form of rowing units employing a flywheel to produce the momentum effect are superior to other units because they closely simulate the feel of rowing a real boat. The momentum effect gives the sensation of accelerating an inertial mass (the flywheel) during the pulling segment of the stroke, a sensation which is similar to that of accelerating a real boat. On the recovery segment the flywheel decelerates to a certain extent but maintains a large portion of its stored energy just as a boat maintains its forward momentum. The momentum effect also serves to establish a steady rhythm which makes the use of the device more enjoyable and is a superior mode of exercise in promoting cardiovascular fitness. Here the flywheel stores energy which has been imparted over a series of strokes, so a deviation in cadence or pulling force will result in a change in energy level. Regaining that level will require a compensating change in power delivered over succeeding strokes, immediately apparent as a change in the resistance offered by the unit. In this way the flywheel functions as a feedback mechanism acting to maintain a consistent rhythm and level of effort, which are desirable in cardiovascular type exercises.

In prior devices using flywheels, rotation is typically impeded by fluid or frictional resistance. Examples of devices employing fluid resistance generally employ ambient air or closed hydraulic media. These include U.S. Pat. Nos. 4,396,188; 4,249,725; and 3,266,801. Examples of devices employing frictional resistance include U.S. Pat. Nos. 4,047,715 and 247,532. These units generally employ friction elements which are held in contact with some surface of the flywheel by the action of weights, springs, setscrews or the like. In fluid resistance units the resistance is generally proportional to the speed of rotation of the flywheel. This is not true of frictional devices.

While these prior art rowing machines produce a momentum effect, they do not also produce sounds which simulate actual rowing. Further, the flywheels used in these devices are typically heavy, cumbersome or both. These qualities reflect adversely in shipping the machines, and in their cost of manufacture. The only known rowing machines which utilize actual water are large, fixed installations where one to eight rowers pull on conventional oars which reach to an open-top body of water. In large facilities of this type, there are two open-top water tanks on either side of the rowers with conduits and pumps to assist in circulating the water through the tanks. These installations are extremely expensive and not portable.

Another desired operating characteristic of rowing machines and the like is to be able to vary resistance of the machine, both before and during exercise to accomodate users having varying physical characteristics and to vary the response of the machine during an exercise. While various adjusting mechanisms are known, most require the user to stop the exercise routine for a period of time which substantially interrupts the rhythm of the exercise.

It is therefore a principal object of this invention to provide a portable rowing machine that provides a momentum effect that closely simulates actual in-water rowing and also simulates the sound of actual rowing.

Another principal object is to provide a rowing machine with the foregoing advantages that is compact and has a comparatively low weight.

Another object is to provide a rowing machine which readily allows an adjustment in the resistance of the machine without substantially interrupting the exercise.

A further object is to provide these advantages while at the same time being mechanically simple and requiring no special water seals around rotating members.

SUMMARY OF THE INVENTION

The rowing machine of the present invention is of the reciprocating type with alternating pulling and recovery segments. The machine is organized about a frame that mounts a small hollow container that holds a supply of water. A paddle or the like is rotatably mounted in the container and coupled, preferably through a double spool and a clutch, to a drive cord and a recoil mechanism. The paddle is oriented to rotate the water about the major axis of the container in response to a pulling movement on the drive cord. The mass of the spinning water produces the momentum effect and turbulence generated in the water provides the desired resistance. In the preferred form the container has a generally cylindrical configuration. Also, the water supply preferably fills less than half the container so that the water will not leak past any rotary couplings or bushings for the paddles when the rowing machine is oriented vertically for storage. The spool is preferably one which wraps the drive cord with a diameter that varies with the degree of wrapping so that an adjustment in the length of the drive cord produces a corresponding change in the rate of rotation of the paddle and hence the resistance of the machine.

To adjust the resistance of the machine on the pulling segment, the invention provides a handle having a central portion that is coupled to the drive cord and a pair of hand grips secured to the central portion. In the preferred form the drive cord is continuous in the region of the handle and secured at one end to the top groove and at its opposite end to the bottom groove of the double spool. The central region of the handle produces a turn in the cord and the handle is configured so that the force of the pulling segment locks the position of the handle on the cord. Rotation of the handle allows it to be moved along the strap to vary the resistance of the machine without substantially interrupting the exercise. In another form, one end of the drive cord is fixed to the central member and wrapped around it, and the hand grips are offset from the central member to develop a moment that resists an unwrapping of the cord on the pulling segment. The moments acting on the handle hold a given degree of wrapping, but a rotation of the handle places it in an orientation to facilitate the winding or unwinding of the cord without interrupting the cadence. In this form a separate recoil cord acts to rewind the double spool.

These and other features and objects of the present invention will be more fully understood from the following detailed description which should be read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in perspective of a rowing machine according to the present invention;

FIG. 2 is a view in vertical section of the rowing machine shown in FIG. 1;

FIG. 3 is a top plan view of the rowing machine shown in FIG. 1;

FIG. 4 is a detail view in vertical section of the drive mechanism and water drum shown in FIGS. 1-3;

FIG. 5 is a view in side elevation of the rowing machine of FIGS. 1-4 stored vertically on one end;

FIG. 6 is a detailed perspective view of the handle shown in FIGS. 1-5 and also showing a mechanism for securing the handle to the frame when the machine is not in use;

FIG. 7*a* shows a locked orientation of the handle shown in FIG. 6;

FIG. 7*b* shows an unlocked orientation of the handle shown in FIG. 7*a;*

FIGS. 8*a* and 8*b* show in top plan view and a view in vertical section respectively, a locked orientation of the central portion of an alternative handle;

FIG. 8*c* shows in vertical section an unlocked orientation of the handle shown in FIGS. 8*a* and 8*b;*

FIG. 9 is a view in vertical section of the seat mounting arrangements of the rowing machine shown in the previous drawings;

FIG. 10 is a view in vertical section of a rowing machine having an alternative arrangement to adjust resistance.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1-3 show a rowing machine 10 that has a frame number 12 capturing a hollow tank 15, containing a drive mechanism 30, and carrying a sliding seat 13 where the user sits when exercising. The tank is preferably a molded plastic which offers a very favorable shipping weight and cost of manufacture when compared to conventional flywheels. A tank diameter of about twenty-two inches has been found to give good results while still being compact, low in weight and portable. A supply of liquid, preferably water, is added to the tank via the opening filled by plug 44 before use. As will be described below, the spinning water supply acts like a flywheel to provide a momentum effect.

In one form illustrated in FIGS. 1-4, a handle 23 attaches to a drive cord 26 which passes horizontally over pulley 27, twists 90 degrees and passes vertically around pulley 28, and finally winds about and fastens to the upper groove of a double spool 29. The drive cord is preferably in the form of a strap and made of webbing. A rewind strap 46, in this form consisting of the opposite end of drive strap 26, winds about the lower groove of the double spool in the direction opposite the drive strap. From the double spool the rewind strap passes vertically around pulley 31, twists 90 degrees and passes horizontally over pulleys 32, 33 and 34, and then returns to the handle via pulleys 35 and 27. Anelastic cord 38 is coupled at one end to pulley 34 and secured at its opposite end to the frame. It draws the pulley 34, and the cord 46 looped around the pulley 34, in a direction which acts to maintain tension in cord 26 during the recovery segment of the stroke.

The double spool 29 is mounted upon a roller clutch assembly 39 through which a shaft 20 is journaled. The shaft connects directly to a paddle 40 which imparts circular motion to a fluid 16, typically water, in the tank 15. The top frame member 12 supports the shaft in suitable bearings 41. A clamping collar 42 secures the shaft against axial movement and provides a takeoff for an instrument 43 which displays rate of paddle rotation and other desired information in appropriate units. The plug 44 allows filling and draining of the tank 15. As shown in FIGS. 2-4, the paddle preferably extends laterally so that it is closely spaced from the side wall of the tank 15, a spacing of ¼ inch being typical. With this arrangement, rotation of the paddle 40 and the water 16 produce a water sound similar to that produced by a rowing shell.

Operation of the device consists of a drive segment of the stroke during which the operator pulls on the handle 23 and a recovery segment during which the recoil mechanism (the shock cord 38 acting on the strap 46 through the pulley 34) returns the handle to an original position for the next drive. During the drive segment unwinding of the drive strap 26 from the double spool 26 rotates the spool in the direction in which the roller clutch assembly 39 engages the shaft 20. Rotation in this direction causes rewind strap 46 to wind on the double spool, and by translation of the pulley 34, stretch the elastic cord 38. On the recovery segment the elastic cord contracts and the rewind strap rotates the spool in the opposite direction thereby rewinding the drive strap. While the spool rotates in this direction the clutch disengages allowing the shaft to continue turning in the first direction.

FIG. 5 shows the rowing machine of the present invention in a vertical orientation for storage. The machine can be easily transported by simply lifting the end opposite the the tank 15, rolling the unit on wheels 50, and then placing it in a full upright position on the wheels 50 and supports 52. Note that the volume of the water supply 16 is preferably less than half the interior volume of the tank 15. As a result, when the machine is stored, the water does not reach the bearings 41 for the rotating shaft 20 and special water seals are not required.

With particular reference to FIG. 4, the drive and recoil mechanisms which also allow a convenient adjustment of the resistance of the rowing machine secure the ends of the drive strap 26 to the upper and lower grooves of the spool 29. The body of the strap forms a loop which passes, via various pulleys and rollers as shown, through both the handle 23 and a pulley 34 linked to the end of the elastic cord 38. The handle 23 is shown here and in FIG. 7*a* in its locked orientation whereby when one pulls on the grips the strap is prevented from slipping with respect to the handle. By changing the location on the strap where the handle is locked, one can alter the proportion between the respective number of winding turns which the strap takes on the upper and lower grooves of the spool. This has the effect of changing the rotational speed of the paddle over a given stoke and the level of resistance as described above. For example, locking the handle at a point closer to the end of the strap fixed to the upper groove of the spool makes the strap unwind from the upper groove and therefore operate at a smaller average diameter and rotate faster over the extent of a given stroke. As the end of the strap unwinds from the upper groove, the opposite end winds up on the lower groove, thus maintaining tension in the loop. Varying the unit's resistance in this way stretches or contracts the elastic cord only to the extent that the aggregate length of strap wound on both grooves changes. The opposite occurs when the handle is moved in the opposite direction as shown by arrow **48** in FIG. *7b*.

The handle shown in FIGS. *7a* and *7b* consists of hand grips **55**, a bent metal tube **58** and a bent metal rod element **59** welded to the tube. In its rest position, the rod ends engage an angle plate **60** mounted on the top frame member **12**. One unlocks the handle by rotating it through almost a full motion, as depicted by arrow **54** to an "unlocked" position shown in FIG. *7b*. In the unlocked position, the strap may be moved freely through an opening **56** formed by the bent rod without substantially interrupting the exercise.

In another form, the level of resistance offered by the rowing machine **10** may be varied by winding or unwinding the drive strap **26'** around the handle **23'** (see FIG. **10**). Winding on the handle causes the drive strap to unwind at its opposite end from the double spool **29'**, thereby reducing the spool's effective diameter. For the distance of handle travel on a given stroke a spool of smaller effective diameter unwinds at a higher rotational speed and spins the fluid in the tank **15'** faster, which yields a proportional increase in resistance. Unwinding the drive strap from the handle reduces the speed of rotation in an opposite fashion. A pair of hand grips **55** on the handle are bent slightly downwardly and away from a central member **57** to produce a moment of force on the pulling segment that resists an unwinding of the strap from the handle. In this form a separate strap **46'** acts to rewind the double spool **29'**. The end of strap **46'** is adjustably secured to frame **12** by means of pulley **48** and sliding buckle **49**. For large adjustments in resistance as described above, sliding buckle **49** adjusts the length of strap **46'** so that elastic cord **38'** operates over a desired range of motion.

The "single strap" arrangement and the handle construction shown in FIGS. *7a* and *7b* are preferred since there is some additional convenience and reliability in operation, because it does not require adjustment of the compensating buckle **49**.

FIGS. *8a*, *8b* and *8c* show an alternative handle arrangement which operates in the same general manner as the handle shown in FIGS. *7a* and *7b*. The user grips a rod or bar **55'** which is straight, not angled forwardly as in the other illustrated embodiments. A bent metal rod element **59'** is secured in the bar **55'** by a pin **90**. The strap **26** in a doubled configuration wraps on a rod **92** welded across the element **59'** and loops around a second rod element **94** also welded across the element **59'**. These rod elements and a portion of the bar **55'** form a central member **57'**. In the normal operating position shown in FIGS. *8a* and *8b*, the tension in the strap creates a frictional force, particularly at the rod **92**, which secures the handle at a selected position on the strap. In the release position shown in FIG. *8c*, the strap can slide over the rod **94** to adjust the position of the handle and hence the resistance of the rowing machine **10**, as described above.

There has been described a rowing machine that is portable, compact and suitable for home use which also closely simulates the feel and sound of actual rowing in a way that had heretofore only been attainable in massive commercial installations used for training competitive rowing crews. The rowing machine has a comparatively low weight for shipping since the water for the flywheel effect can be simply omitted or drained from the container. The machine also allows a user to change the resistance of the machine without substantially interrupting the exercise. Moreover, all of these advantages are provided with a comparatively simple, cost-effective design that does not require expensive water seals.

While the invention has been described with respect to its preferred embodiments, it will be understood that various modifications and alterations will occur to those skilled in the art. For example, while the invention has been described with respect to a rectangular paddle rotating in a cylindrical tank approximately half filled with water, various shapes of tanks, arrangements for propelling the water and generating turbulence and various other liquid levels are possible. These and other modifications and variations are intended to fall within the scope of the appended claims:

What is claimed is:

1. In an exercise device having frame means, a drive cord capable of reciprocal motion during cycles of operation including a pulling segment in which the drive cord is unwound from a recoil mechanism in a first direction and a recovery segment in which the drive cord moves in the direction opposite said first direction and is rewound on said recoil mechanism said recoil mechanism being mounted on the frame means, the improvement comprising:

a hollow container mounted on said frame;

a supply of liquid held in said container,

liquid rotating means rotatably mounted within said container at its center and spaced from the walls of said container to rotate said supply of liquid within said container in response to movement of said drive cord during said pulling segment, said container having an inner surface in contact with said liquid, said inner surface being shaped to allow free movement of the liquid thereby allowing said supply of liquid to continue to rotate within said container during said recovery segment to produce thereby a liquid flywheel moving within said container and thereby maintaining the rotation of the liquid rotating means during the recovery segment and

translating means mounted on said frame means and operatively connected to said liquid rotating means for translating a reciprocating motion of said drive cord during each cycle of operation into a one-way rotation of said liquid rotating means in response to said pulling segment of said cycle of operation, said translating means being coupled to said drive cord and said recoil mechanism,

said supply of liquid when rotating producing resistance to said pulling segments due principally to turbulence at the liquid-container interface, and

said liquid rotating means being capable of rotating in unison with said rotating liquid during said pulling and recovery strokes.

2. The improved exercise device of claim **1** wherein said container is closed.

3. The improved exercise device of claim **1** wherein said supply of liquid fills less than half of the interior volume of said container.

* * * * *

United States Patent [19] [11] **4,077,626**
Newman [45] * **Mar. 7, 1978**

[54] **EXERCISING MACHINE**

[76] Inventor: **Joe Westley Newman,** 1521 E. Deerwood Dr., Mobile, Ala. 36618

[*] Notice: The portion of the term of this patent subsequent to Dec. 10, 1995, has been disclaimed.

[21] Appl. No.: **523,458**

[22] Filed: **Nov. 13, 1974**

[51] **Int. Cl.**[2] **A63B 21/02**
[52] **U.S. Cl.** **272/128;** 272/132; 272/134; 272/DIG. 5
[58] **Field of Search** .... 272/58, 73, 79 R, 79 D, 272/83 A, 83 R, 128

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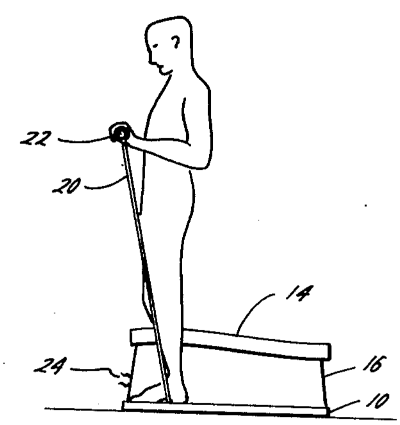
Primary Examiner—Richard C. Pinkham
Assistant Examiner—T. Brown
Attorney, Agent, or Firm—Arthur M. Dula; Ned L. Conley; Murray Robinson

[57] **ABSTRACT**

An exercise apparatus comprising a platform, a bench mounted on the platform and adapted to provide a foot space on each side of said bench, a bar transversing said bench attached at its ends to a pair of lines, a linear to rotational motion converter operably attached to said lines and adapted to convert the linear extension of said lines to rotational motion and to rewind said lines when said extension is relaxed, and a flywheel responsive to said linear to rotational motion converter and adapted so the pulling of said lines results in the rotation of said flywheel.

16 Claims, 7 Drawing Figures



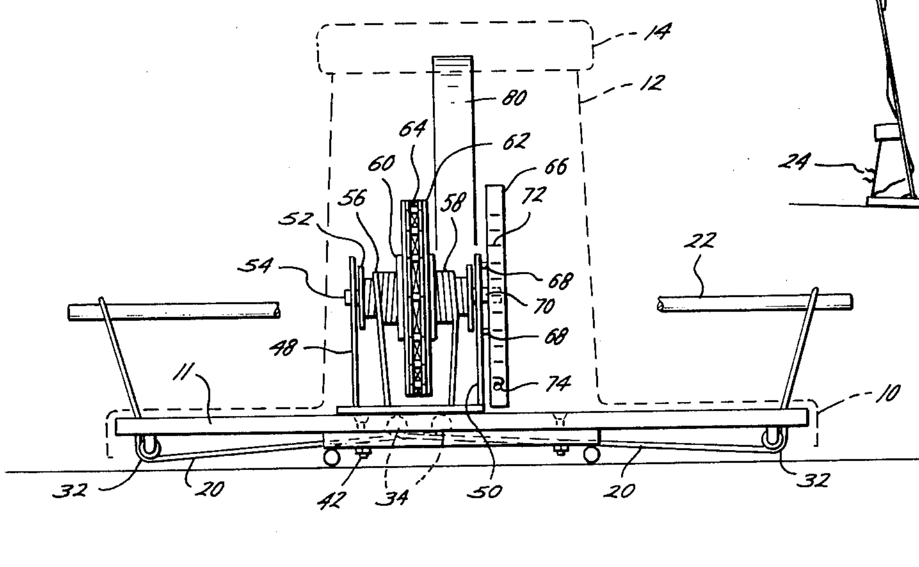


Fig. 1

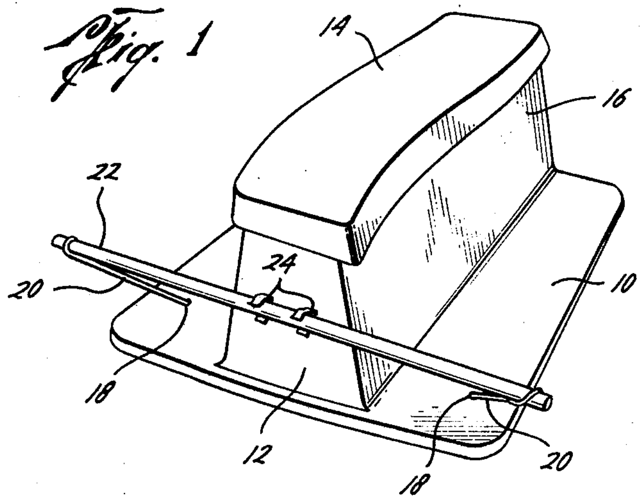


Fig. 2

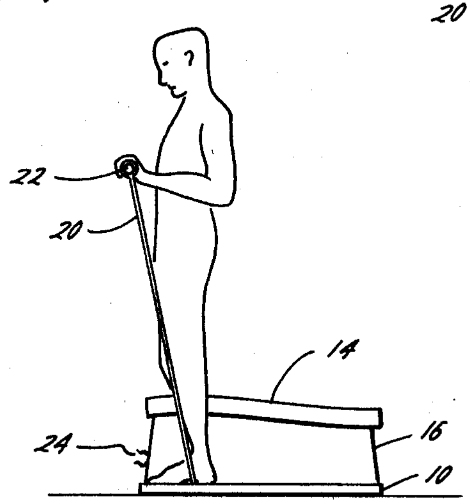
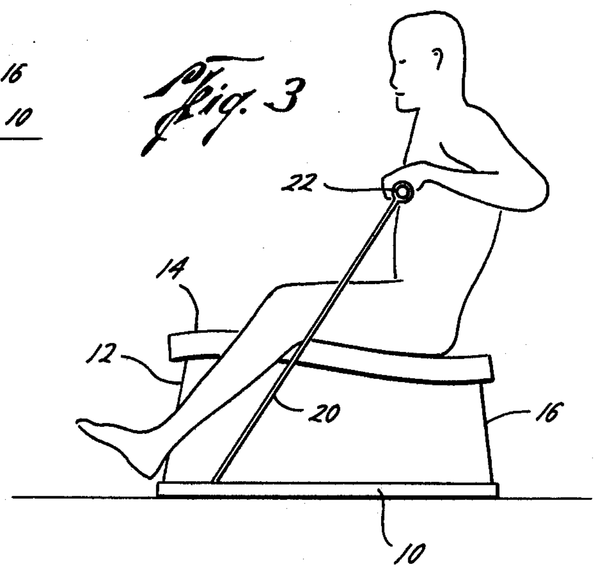


Fig. 3



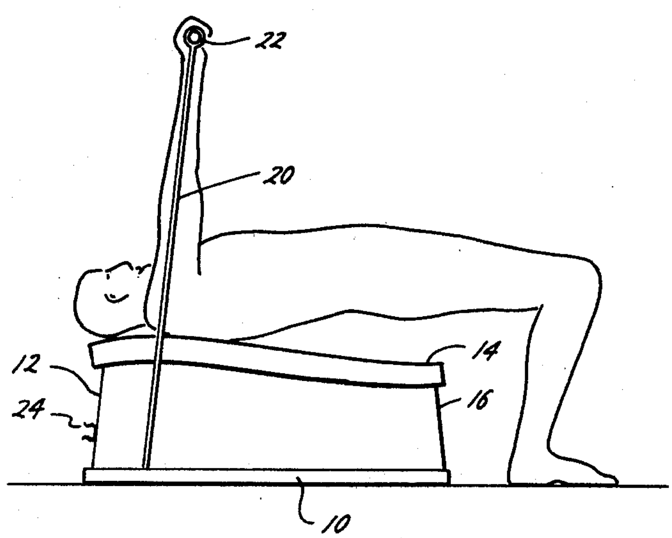


Fig. 4

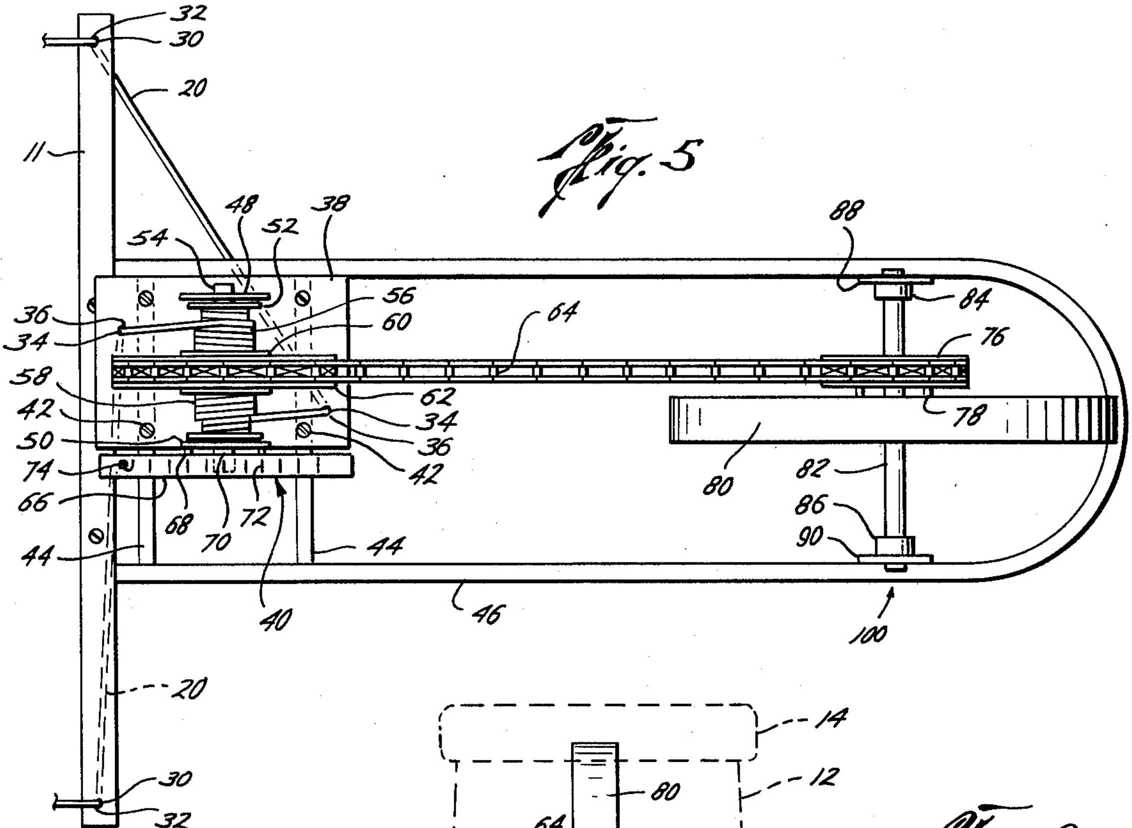


Fig. 5

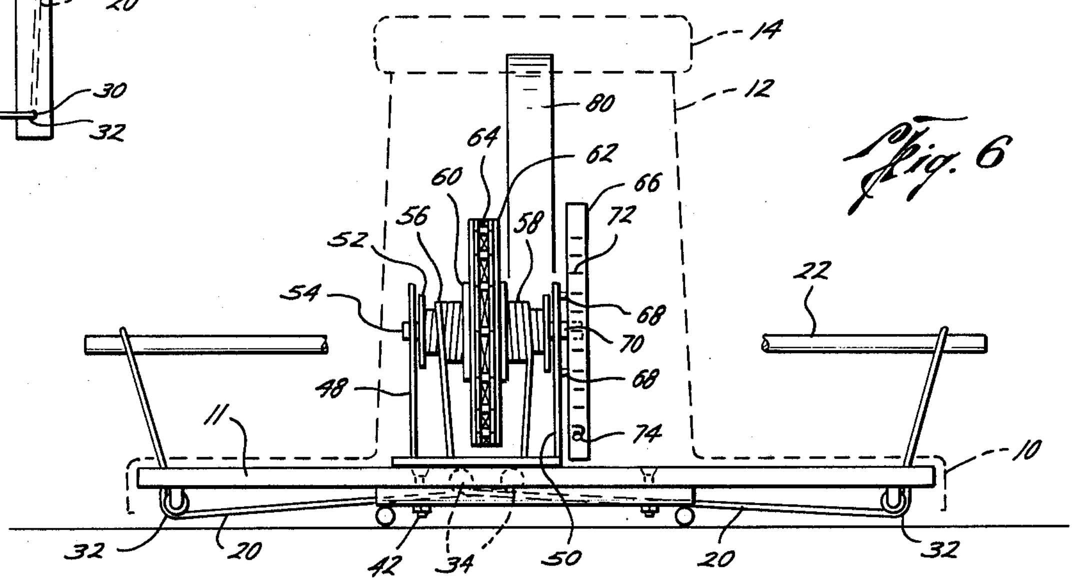


Fig. 6

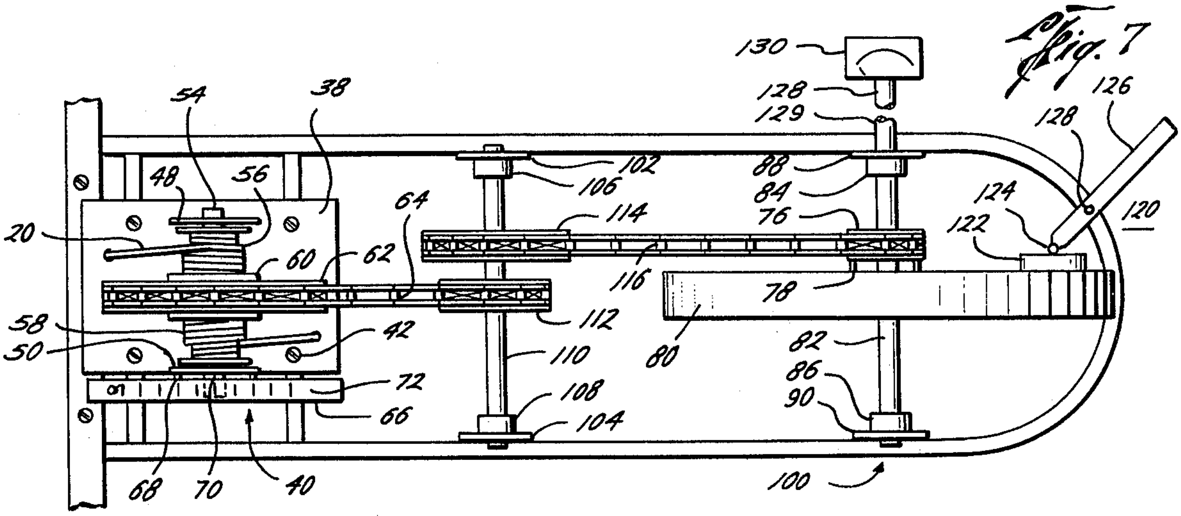


Fig. 7

EXERCISING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to exercise apparatus, and more particularly it relates to apparatus in which the energy of exercising is imparted to a flywheel as angular momentum and which is useful for a variety of exercises and for use in a large variety of different positions.

2. Description of the Prior Art

It is old in the art to exercise by placing a number of heavy objects on a bar and then lifting the bar against the acceleration of gravity to perform a variety of different exercises. A large variety of exercises may be performed to exercise various muscles of the body. Since different muscles require different varieties and magnitudes of exercise, it is necessary to change the weights on a bar during an exercise period in order to provide a well rounded exercise program.

It is also well known to exercise by applying forces exerted by muscles in the body against some fixed resistence, such as the friction pads in a rowing machine or the springs of a pull on grip.

The use of heavy weights in the usual home is unsatisfactory for a number of reasons. They must be used in an area where nothing will be damaged if a weight is accidentally dropped, the floor must be one which will withstand damage by the weights, and storage is difficult. Weights are also found unsatisfactory because of the necessity of lowering weights once they have been lifted. The user does not build strength lowering a weight, but lowering weights does burn up energy and saps his strength. Thus, in lifting weights the user must retain enough strength to lower the weight once it has been lifted. Presence of the weight at the end of the lift is particularly objectionable in such lifts as a bench press, where the user lies with his back on a bench and presses the weight upward. It may be necessary to have two helpers present to lift the weights on and off. Additionally in order to perform a well rounded exercise program with weights, it is necessary to have a number of pieces of equipment, such as, for example, a bench for bench presses and a rack to receive the weights for various exercises.

The use of the fixed resistance, such as pulling against the frictional drag in a rowing machine, is also unsatisfactory for a number of reasons. The equipment tends to wear out rather easily and frictional surfaces in the equipment must be refinished or replaced.

More importantly the force exerted by a constant frictional resistence differs from the force exerted on a weight by gravity. Gravity is an accelerative force and the mass of the weights to be lifted possesses inertia. An inertial mass being lifted in an accelerative field such as a gravity field has lift characteristics that are very different from the lift characteristics provided by a fixed resistance such as a frictional stop or spring, which exert the same resistance at all times or an increasing resistance. A weight will be initially very difficult to lift, requiring a maximum effort and, once this initial inertia has been overcome and the weight begins to move, it will tend to keep moving, thus making completion of the lift easier and allowing a greater weight to be lifted. This inertial resistance also differs from the resistance provided by a spring. A spring, by Hooke's law, is initially easy to compress or extend and grows more difficult to compress or extend as extremes of compression or extension are attained. Compressing or extending a spring thus provides the opposite resistance characteristic from lifting a weight under the acceleration of gravity.

Thus none of the common substitute exercises for the lifting of weights attached to a bar in a gravity field substantially duplicate the effect of such weight lifting on a exerciser's muscles, i.e., that of a inertial resistence followed by accelerative resistance, as does the lifting of weights.

SUMMARY OF THE INVENTION

The present invention substitutes the rotational inertia of a flywheel for the linear inertia of a set of weights mounted on a bar. The invention has a bar to which are attached lines. These lines operably engage a linear to rotary converter that converts the linear motion of the lines, and thus of the bar, to the rotational motion of a flywheel. This rotational motion is used to accelerate the flywheel that provides the rotational inertial resistence to the exerciser's muscles and simulates the effects of gravity on a set of lifted weights.

It is therefore an object of this invention to provide an apparatus by which the advantage of weight lifting can be obtained without the attendant disadvantages.

It is another object of the invention to provide exercise apparatus which may be used to perform weight lifting exercises but which, instead of using weight, uses the rotational inertia of a flywheel that may be changed by changing the gear ratio between the flywheel and a linear to rotary motion converter.

It is another object of the invention to provide an exercise apparatus that provides a resistance that is a direct function of the force applied to it in a given time interval and an inverse function of the frequency with which force is so applied.

Still another object of this invention is to provide an exercise apparatus which is suitable for a large variety of exercises and exercise positions while not requiring any additional equipment for different exercises.

It is yet another object of the invention to provide an exercise apparatus wherein the force resisting movement by the user is effective only during the time the user is exerting force against it.

Another object of the invention is to provide an exercise apparatus which is equally useful for the performance of exercises in the building of high strength muscles and for exercises principally useful in figure conditioning.

Other objects and advantages of the apparatus of this invention will become more apparent upon consideration of the following description and the accompanying drawings wherein:

FIG. **1** is an isometric view of a preferred embodiment of the exercise apparatus of this invention;

FIG. **2** is a reduced side view of the embodiment FIG. **1** showing one of the methods of use;

FIG. **3** is another side view of the embodiment to FIG. **1** showing another method of use;

FIG. **4** is another side view of the embodiment of FIG. **1** showing still another method of use;

FIG. **5** is a top view of the apparatus of the invention;

FIG. **6** is a somewhat schematic front view of the apparatus illustrated in FIG. **5**;

FIG. **7** is a top view of another embodiment of the apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The embodiment shown in FIG. **1** comprises a platform or base member **10** having disposed substantially centrally thereof adjacent one end of housing **12**. A bench **14** is mounted on top of the housing and extends longitudinally over the platform and substantially centrally thereof to the opposite end of the platform where it is supported by opposite end **16** of housing **12**. The bench has a width such that it can be comfortably straddled by a person standing astride it, usually 8 to 10 inches, and no more than about 15 inches, and preferably has a length approximately equal to the length of the torso of a user who lies on the bench in the manner shown in FIG. **4**. The preferred length is 30 to 36 inches, but lengths down to about 20 inches may be used. Preferably the top of the bench is contoured in the manner shown so that it is slightly higher and convexly curved at the housing end and flat to concavely curved at the frame end. For comfort the top of the bench would be padded. The platform, housing, and bench may be made of any suitable material, and preferably comparative light weight, high strength materials are used so that the apparatus is portable. Glass-reinforced plastic such as polyester resins are highly satisfactory, and may be provided with molded-in inserts of metal or other material where additional strength is required.

Adjacent to housing end of this form and near each edge a boss **18** is provided, through each end of which a line **20** extends. The lines **20** are preferably high strength, highly flexible, non-elastic cords, for example made of plaited nylon. The lines are fastened to opposite ends of a bar **22**. The bar **22** is, in the storage position shown in FIG. **1**, retained by spring clamps **24**.

As best seen in FIG. **5**, the lines **20** extend through holes **30** in the bosses on the edge of the platform and run over pulleys **32** to pulleys **34** and through holes **36** in plate **38** to a linear to rotary motion converter **40**. Plate **38** is attached by screws **42** to bars **44** which run transverse to frame **46**. The holes **30** may be lined with a material such as nylon or teflon to reduce friction if the lines rub as they pass through.

As is best seen in FIG. **6** the linear to rotary motion converter comprises base **38**, which is attached as described above to frame **46** and fits within housing **12**. The pair of pulleys **34** mounted on the underside of Base Plate **38** serve as guides to the lines **20** through openings **36** in the base plate. A pair of upstanding bulkheads **48** and **50** form, together with base **38**, the main frame of the linear to rotary motion conversion mechanism. The bulkheads are provided with aligned bearings **52** that rotably receive a shaft **54**. A pair of spools **56** and **58** are fixed co-axially on either side of a ratchet transmission mechanism **60**. The assembly of the two spools and the ratchet transmission mechanism is affixed on the shaft **54** between the bulkheads **48** and **50** and are adapted for rotation therebetween.

As is apparent in the drawing, the two spools windably accept the two lines **20** and the central transmission **60** is mounted co-axially on the shaft between them.

The ratchet type transmission **60** which allows the rotation of the spools to engage sprocket **62** and, via chain **64** and sprocket **76**, flywheel **80**, is very well known to the mechanical arts. This type of transmission is used in the chain drive of virtually all bicycles and motorcycles, is old in the art and will not be described further herein.

A sprocket wheel **60** is mounted annularly about and constrained to rotate with the outer perimeter of transmission **60**. The sprocket wheel is adapted to receive a chain **64**.

A spring housing **66** is mounted on one end of shaft **54**. The housing is fastened to bulkhead **50** as by bolt **68** and has a central aperture that fits loosely around a reduced portion **70** of the shaft **54** that extends outwardly from the bulkhead. In the embodiment shown, the spring housing is a flat, substantially cylindrical, member adapted to enclose spiral spring **72**. The spiral spring **72** is fastened at one end in a slot in the reduced end portion of the shaft, and is fastened at its other end to the spring housing by means of a bolt **74**. The spiral spring is located in position within the spring housing in such a manner that the rotation of the shaft **54** in the clockwise direction, a viewed from the spring end, causes the spring to be wound up. The spring is preferably of the type that it exerts a substantial constant torque on the shaft as it unwinds from the first condition where the lines are fully extended to the second condition where the lines are fully rewound. Preferably, the spring exerts only sufficient torque to insure rewinding of the lines, and usually a torque sufficient to exert a pull of 5 to 20 pounds on the lines is sufficient, although a pull of up to 30 pounds would not be excessive in some instances.

As is shown in FIG. **5**, chain **64** operably engages sprocket **62** at the linear to rotary motion converter and also operably engages sprocket **76** at flywheel assembly **100**. Sprocket **76** is attached, as by bolts **78**, to fly wheel **80**. Flywheel **80** is rotatably mounted on shaft **82**. Shaft **82** is rotatably received in bearings **84** and **86** stanchions **88** and **90** respectively. These stanchions are attached at their respective bases to frame **46**. The chain, sprockets and flywheel are all covered by housing **12** in normal operation near frame end **16**. Flywheel **80** can be made of any convenient material and generally weights about 80 pounds, although a heavier flywheel may be used to advantage in some versions of the present invention. The ratchet **62** of the motion converter **40** and the ratchet **76** of flywheel **80** are substantially linearly aligned within housing **12** to prevent the twisting and binding of chain **54** operably engaged therebetween. FIG. **6** is a front view of the embodiment shown in FIG. **5**.

FIG. **7** illustrates an alternate embodiment of the invention wherein a set of gears is located intermediate between the linear to rotational motion converter **40** and the flywheel apparatus **100**. As shown in FIG. **7**, two stanchions **102** and **104** are located approximately midway between the flywheel and the converter mechanism, and have their respective bases attached to frame **42**. The upper end of stanchions **102** and **104** are provided with bearings **106** and **108** respectively that rotatably receive therebetween an axle **110**. Axle **110** has a first sprocket **112** that is substantially linearly aligned with sprocket **62** of the linear to rotary motion converter **40**, and a second sprocket **114** which is substantially linearly aligned with sproket **76** attached to flywheel **80**. Chain **64** operably engages both sprocket **112** and sprocket **62**. Chain **116** operably engages both sprocket **114** and sprocket **76**. The ratio of the diameters of the two sprockets, **112** and **114**, on axle **110** determine the turning ratio between the sprocket **62** of the linear to rotary motion converter and the flywheel **80** attached a sprocket **76**. The ratio of these two diameters may be varied as desired to create either a higher or lower turn ratio whereby the force required to rotate the flywheel is varied.

FIG. 7 also shows a caliper brake **120**. Caliper brake **120** has a pad **122** attached by a pivot **124** to lever **126**. Lever **126** is attached to frame **42** by a pivot **128**. When lever **126** is pulled pad **122** frictionally engages flywheel **80** to oppose its rotation.

Referring again to FIGS. **5** and **6**, the preferred embodiment of the invention operates as follows. An exerciser grasps bar **22** as shown in FIGS. **2**, **3** or **4** and manipulates bar **22** to perform exercises. Bar **22** is attached at its ends to lines **20** and when bar **22** is moved, lines **22** extend. The extension of lines **20** causes the unwinding of said lines from spools **56** and **58**. This unwinding occurs in a clockwise direction as viewed from the end **70** of shaft **54**. As lines **20** unwind, therefore, two things happen. First, tension in spring **72** increases to opposes the unwinding of lines **20** and secondly, the ratchet type transmission in transmission **60** causes sprocket wheel **62** to revolve in a clockwise direction with spool **56** and **58**. This movement of sprocket **62** causes chain **64** to drive spocket **67** and spin flywheel **80** on axle **82**. Since flywheel **80** has a certain amount of rotational inertia, depending on its mass and diameter, the flywheel's rotation will tend to oppose the unwinding of lines **20**.

When the user has elevated the bar to the position desired, he may then relax the force applied to the bar without any danger of the bar suddenly falling, because the only forces tending to pull the bar downwardly are its own weight and the force of spiral spring **72** acting to rewind lines **20** on spools **56** and **58**.

Upon lowering the bar, the force of wound spring **72** causes line **20** to rewind on spools **56** and **58**. Rotation of the shaft **50** in a direction to rewind the lines is not resisted by the flywheel because the spools are free to rotate in a counter clockwise direction as viewed from the spring end. This is another well known characteristic of the old transmission **60** used in this invention. Thus, when bar **22** is pulled extending lines **20**, the linear to rotary motion converter causes the rotation of flywheel **80**. When the user is no longer extending lines **20** or is lowering the bar, spring **72** acts to rewind line **20** on spools **56** and **58**.

The harder the user pulls on bar **22** and the more forcefully line **20** is extended, the greater will be the amount of energy transferred by the rotary converter **40** to flywheel **80**. After the lines **20** are rewound onto spool **56** and **58**, the user may extend the lines again by pulling on bar **22** to add additional velocity to the flywheel.

As shown in FIG. **7**, the amount of extension of line **20** needed to cause flywheel **80** to go through one complete revolution may be varied by the addition of an intermediate axle **110** having sprockets **112** and **114** that have differing diameters. As shown, sprocket **112** is smaller than sprocket **114**. This causes fewer turns of sprocket **62** on the linear to rotary converter to result in more turns of sprocket **78** that rotates with flywheel **80**. By varying the diameter of these intermediate sprockets, a wide range of turn ratios may be achieved. Operationally this allows the pull required on line **20** to spin the flywheel **80** to be made as heavy or as light as desired. FIG. **7** also illustrates the use of a handbrake **120** on flywheel **80**. Handbrake **120** is operated by pulling lever **126** that causes pad **122** to frictionally engage the surface of flywheel **80**. This frictional resistance opposes the rotation of flywheel **80** and is a way of stopping its rotation after exercising. Also shown in FIG. **7** is a flexible shaft **128** operably attached to the end **129** of axle **82**. This flexible shaft drives tachometer **130**. Tachometer **130** indicates the number of revolutions per minute made by flywheel **80** and allows the user of the invention to obtain an objective measure of the amount of effort he has been exerting on bar **22**. The tachometer may be calibrated in units of force, such as pounds of pull, or in units of rotational velocity, such as revolutions per minute.

The normal combination of this invention is suitable for a large number of different exercises, as shown for example in FIGS. **2**, **3** and **4**. The width of the bench is such as to allow the user to stand astride it while doing various standing exercises, and forces the user to spread his feet to approximately the right distance apart, i.e. shoulder width, for performing these exercises. The width and length of the bench are also dimensioned for the user to sit on to perform, for example, a rowing exercise shown in FIG. **3**, and for the user to lie on to perform a bench press, for example, as shown in FIG. **4**. The lines are spread apart at the point where they pass through the hole **18** in the platform a sufficient distance to allow the feet to be placed between the lines and the housing **12**, and sufficient to clear the torso of the user.

Although a preferred embodiment of the invention has been shown and described herein, the invention is not limited to this embodiment, but only as set forth by the following claims.

I claim:

1. An exercise apparatus comprising

a platform,

a bench on said platform positioned to provide a foot space on said platform on each side of said bench,

a pair of stanchions positioned apart on said platform;

a flywheel rotateably mounted between said stanchions;

linear to rotational motion conversion means for converting linear motion to rotational motion adapted to impart said rotational motion to said flywheel;

a pair of lines operably attached to said linear to rotational motion means and leading to either side of said bench, and

a bar transversing said bench and attached to said lines.

2. Exercise apparatus as defined by claim **1** wherein said bench has a width no greater than 15 inches and a length of at least 20 inches.

3. Exercising apparatus as defined by claim **1** and including a brake adapted to oppose the rotation of said flywheel when engaged.

4. Exercise apparatus comprising

a bench,

a platform supporting said bench and extending on each side of said bench to provide a resting place for the user's feet when doing standing exercises,

a bar traversing said bench and movable to a variety of positions above said bench,

a pair of lines attached to said bar and extending downwardly therefrom,

a spool supported by said platform adapted to have said lines wound thereupon,

means operably engaging said spool adapted to rotate it in a line winding direction,

a pair of stanchions positioned apart on said platform,

a flywheel rotatably mounted between said stanchions, means operably engaging said spool adapted to impart rotational motion to said flywheel when said spool is rotated in a line unwinding direction.

5. Exercise apparatus as in claim **4** including a brake adapted to selectably oppose the rotation of said flywheel.

6. Exercise apparatus as in claim **5** including a tachometer operably engaging said flywheel and adapted to display said flywheel's rotational velocity.

7. Exercise apparatus as in claim **6** wherein said tachometer is adapted to display the average velocity of said flywheel over a desired period of time.

8. Exercise apparatus comprising

a platform adapted to rest on the floor and on which the user may take a variety of positions for exercising,

a pair of lines extending upwardly at opposite sides of said platform,

a pair of stanchions positioned apart on said platform;

a flywheel having rotational inertia rotatably mounted between said stanchions;

linear to rotational motion conversion means for converting linear motion to rotational motion and adapted to impart said rotational motion to said flywheel,

said lines being operably attached at their lower ends to said linear to rotational conversion means and spaced apart a sufficient distance for the body of a user to fit therebetween and for the user to take a variety of positions between the lines,

a bench on said platform between the upwardly extending lines having a width such that it can be straddled by a user in standing position, and

a bar affixed to the upper ends of said lines so that the bar extends across the bench in a position to be elevated against the rotational inertia of said flywheel by a user straddling the bench or lying on his back on the bench.

9. Exercise apparatus as defined by claim **8** where in the bench has a width such that it can be comfortably straddled by the user with his feet spread apart no further than his shoulder width, and a length sufficient to support substantially the entire torso of the user.

10. Exercise apparatus as defined by claim **8** wherein said linear to rotational motion conversion means comprises

a spool means on which said lines may be wound,

means for applying a rotational force generated by the unwinding of said lines to said flywheel, and

means for exerting a rewinding torque on said spool means sufficient to rewind said lines.

11. Exercise apparatus comprising,

a frame,

a shaft, rotatably mounted on said frame,

a flywheel mounted on said shaft for rotation therewith,

a linear to rotational conversion means for converting linear force to rotational force comprising,

a spool rotatably mounted on said frame,

a frame sprocket attached to said spool adapted to rotate therewith,

a line attached to said spool adapted to wind onto said spool upon rotation of said shaft in a first direction and to unwind from said spool upon rotation in a second direction,

a chain engaging said first sprocket and a second sprocket attached to said flywheel and adapted to rotate therewith when said spool rotates in said second direction and to automatically disengage when said spool rotates in said first direction,

means on the end of said line adapted to be grasped by the user for pulling said line to unwind it from the spool, and

means mounted on said frame engaging said shaft exerting a torque on said shaft in said first direction sufficient to rewind said line on said spool when no pull is being exerted on said line.

12. Exercising apparatus as in claim **11** wherein said connecting means includes transmission means for varying the number of said rotations of said flywheel per each rotation of said spool in said second direction.

13. Exercise apparatus as in claim **12** including a brake adapted to selectably oppose the rotation of said flywheel.

14. Exercise apparatus as in claim **12** and including a tachometer operably engaging said flywheel and adapted to display said flywheels rotational velocity.

15. Exercise apparatus as in claim **14** wherein said rotational velocity is displayed as a time average.

16. Exercise apparatus as in claim **20** and including

a substantially flat generally rectangular platform adapted to rest on the floor and on which the user may take a variety of positions for exercising,

a bench extending longitudinally of said platform and covering said flywheel, transmission means and linear to rotational converter, said bench having a width such that it can be comfortably straddled by the user with his feet resting on the platform and spread apart no further than his shoulder width, and having a length sufficient to support substantially the entire torso of the user;

wherein said pair of lines extends from said spool across the platform below its upper surface to opposite sides of said platform and upwardly therefrom at a distance apart sufficient for the user's foot to be placed on the platform between the line and the bench on each side and sufficient for the body of the user to fit between the upwardly extending lines and for the user to take a variety of positions therebetween, and

a bar affixed to the upper ends of said lines so that the bar extends across the bench in a position to be elevated against the force reaction mechanism by a user straddling the bench or lying on his back on the bench.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 4,077,626 Dated March 7, 1978

Inventor(s) Joe Westley Newman

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 25, change "on" to -- or --.
Column 3, line 53, change "rotably" to -- rotatably --.
Column 4, line 38, change "weights" to -- weighs --.
Column 4, line 60, change "sproket" to -- sprocket --.
Column 5, line 18, change "opposes" to -- oppose --.
Column 5, line 22, change "spocket" to -- sprocket --.
Column 6, line 37, change "rotateably" to -- rotatably --.
Column 6, line 45, change "transversing" to -- traversing --.
Column 7, line 3, change "unwinding" to -- winding --.
Column 8, line 32, change "20" to -- 11 --.

Signed and Sealed this

Fifth **Day of** *June 1979*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

DONALD W. BANNER
Commissioner of Patents and Trademarks

United States Patent [19] | [11] Patent Number: 5,033,733
Findlay | [45] Date of Patent: Jul. 23, 1991

[54] **STAIR CLIMBING EXERCISE APPARATUS**

[76] Inventor: **Nathanial B. Findlay**, 1045 Belvedere Ave., Apt. #226, Quebec, Quebec, Canada, G1N 4L4

[21] Appl. No.: **595,829**

[22] Filed: **Oct. 10, 1990**

[51] **Int. Cl.**[5] **A63B 23/00**

[52] **U.S. Cl.** **272/70**; 272/132

[58] **Field of Search** .... 272/69, 70, 71, 72, 272/73, 128, 132, 134; 128/25 R, 25 B

[56] **References Cited**

U.S. PATENT DOCUMENTS

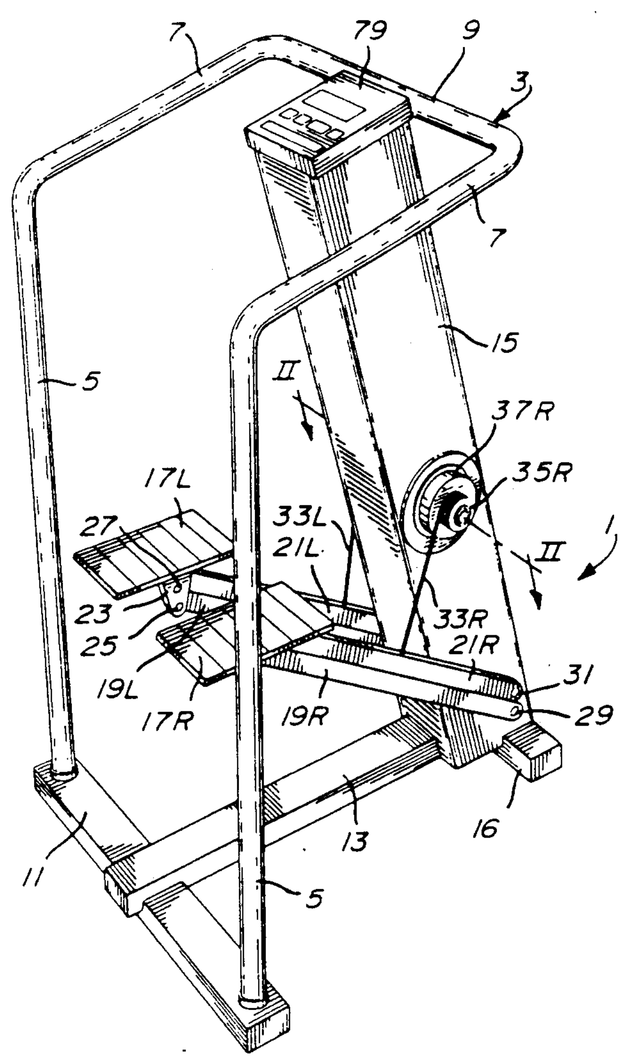
4,718,665 1/1988 Airy et al. 272/132
4,949,993 8/1990 Stark et al. 272/70

Primary Examiner—Stephen R. Crow
Attorney, Agent, or Firm—Foley & Lardner

[57] **ABSTRACT**

A frame structure mounts two side-by-side steps which are pivotally connected to the frame structure for up-and-down motion. The first step is connected, via a strap, to a first pulley, the strap being wrapped around the pulley. The second step is connected by a second strap to the second pulley and the second strap is wrapped around the second pulley. A shaft extends between the first and second pulleys and the first pulley is connected to the shaft when the pulley rotates in one direction but is not connected to the shaft when it rotates in the other direction. The second pulley is, likewise, connected to the shaft when it rotates in the same one direction but is not connected to the shaft when the pulley rotates in the other direction. The resistance element of the apparatus is an electromagnetic brake which includes a rotatable armature, and the rotary motion of the shaft is transmitted to the armature by a planetary gear arrangement.

10 Claims, 2 Drawing Sheets



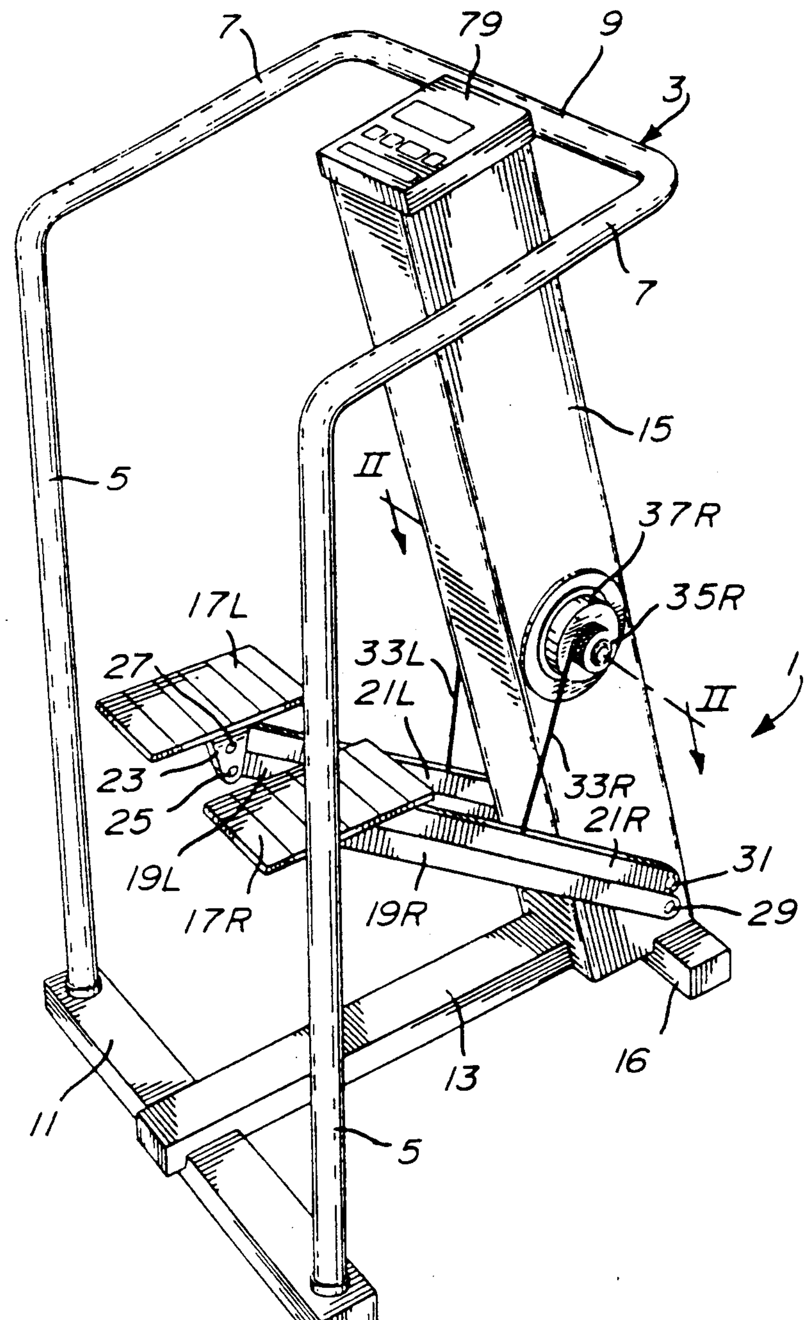

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FIG. 1

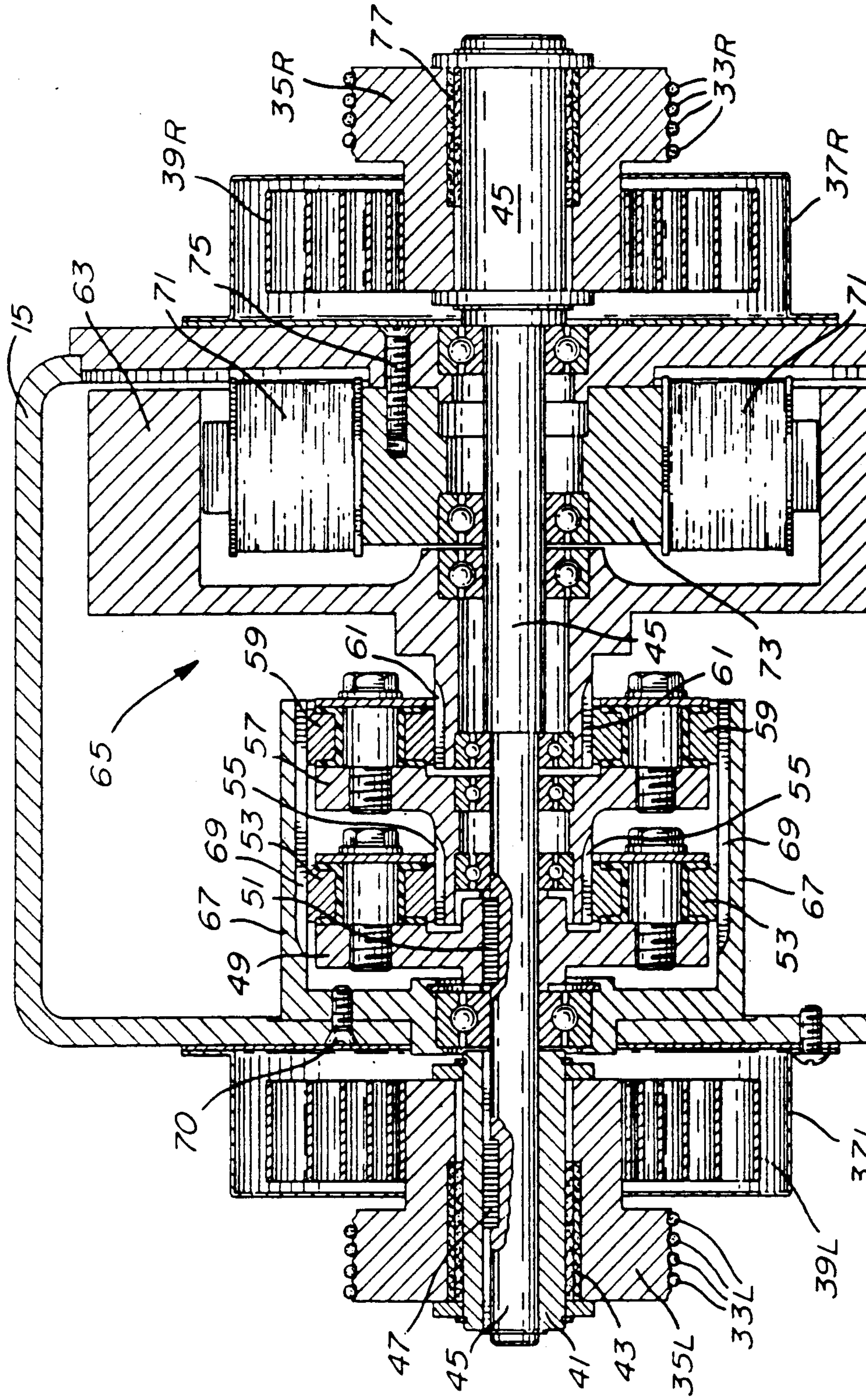
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FIG. 2

STAIR CLIMBING EXERCISE APPARATUS

BACKGROUND OF INVENTION

1. Field of the Invention

The invention relates to a stair climbing exercise apparatus. More specifically, the invention relates to such an apparatus wherein the up-and-down motion of the steps of the apparatus is translated to rotary motion, and the rotary motion is transmitted, by a planetary gear arrangement, to a resistance element which provides the exercise resistance.

2. Description of Prior Art

Stairway exercise apparatus are known in the art as illustrated in, for example, U.S. Pat. No. 4,708,338, Potts, Nov. 24, 1987, U.S. Pat. No. 4,676,501, Hoagland et al, June 30, 1987, U.S. Pat. No. 4,720,093, Del Mar, Jan. 19, 1988, U.S. Pat. No. 4,600,187, Schenker, July 15, 1986, and U.S. Pat. No. 4,685,669, DeCloux, Aug. 11, 1987.

The '338 patent teaches an apparatus in which each of the pedals operate independently. Each pedal drives a pedal sprocket, which, in turn, drives a drive sprocket. However, the pedal sprockets drive the drive sprocket only in one direction of travel of the respective pedal sprockets. The drive sprocket, through a transmission system, drives an alternator shaft, and the alternator provides the exercise resistance. The pedals are returned to a rest position by a spring.

In the exercise machine of the '501 patent, which includes foot pads, exercise is performed by shifting the weight of the user from one side to another. Electric motors raise and lower the foot pads.

The stair climbing exerciser of the '093 patent has two steps which are connected, via chains, to sprockets. The sprockets are connected, via one-way drivers, to a flywheel so that the flywheel is rotated only by rotation in one direction of the sprockets. The steps are interconnected for reciprocal motion so that when a user drives one of the steps downwardly, he simultaneously drives the other step upwardly.

The step arms of the steps of the stair climbing exerciser of the '187 patent are connected to either end of a braked rocker plate. The braked rocker plate provides the exercise resistance and also provides reciprocal movement of the two steps.

In the '669 patent, each step of a stair climbing exerciser is connected to the piston of a separate piston and cylinder arrangement. The piston and cylinder arrangements provide the exercise resistance. In addition, the piston and cylinder arrangements are interconnected to provide reciprocal movement of the steps.

SUMMARY OF INVENTION

It is noted that none of the prior art apparatus use planetary gear arrangements for transmitting rotary motion.

It is therefore an object of the invention to provide a stair climbing exercise apparatus which uses a planetary gear arrangement.

In accordance with the invention, the up-and-down motion of the steps of a stair climbing exercise apparatus is translated to rotary motion, and the rotary motion is transmitted by a planetary gear arrangement to a resistance element which provides the exercise resistance.

In accordance with a particular embodiment of the invention there is provided a stair climbing exercise apparatus, comprising:

- a frame structure;
- a first step and a side-by-side second step, said steps being pivotally connected to said frame structure for up-and-down motion thereof;
- a first rotary member mounted on said frame structure adjacent said first step and a second rotary member mounted on said frame structure adjacent said second step;
- a first strap means having one end connected to said first step and the other end connected to said first rotary member whereby, when said first step is moved from an upward to a downward position, said first rotary member is caused to rotate in one direction;
- a second strap means having one end connected to said second step and the other end connected to said second rotary member whereby, when said second step is moved from an upward to a downward position, said second rotary member is caused to rotate in said one direction;
- shaft means extending between said first rotary member and second rotary member;
- first connecting means connecting said first rotary member to one end of said shaft means such that said shaft means rotates with said first rotary member when said first rotary member rotates in said one direction and does not rotate with said first rotary member when said first rotary member rotates in an opposite direction;
- second connecting means connecting said second rotary member to the other end of said shaft means such that said shaft means rotates with said second rotary member when said second rotary member rotates in said one direction and does not rotate with said second rotary member when said second rotary member rotates in said opposite direction;
- an exercise resistance element;
- a planetary gear arrangement for transmitting rotation of said shaft means to said resistance element.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be better understood by an examination of the following description, together with the accompanying drawings, in which:

FIG. **1** is a perspective view of the stair climbing exercise apparatus in accordance with the invention; and

FIG. **2** is a section through II—II of FIG. **1** illustrating the planetary gear transmission system.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring first to FIG. **1**, the stair climbing exercise apparatus, illustrated generally at **1**, comprises a tubular support member **3** having upright portions **5**, horizontal portions **7** and a connecting bar **9**. As illustrated in FIG. **1**, the entire tubular support member can be formed as a single integral unit.

Disposed between the bottom ends of the upright portions **5** is a cross-horizontal floor member **11**. Stabilizer **13** extends from the floor member **11** to the bottom end of a tubular stand **15** which also includes a cross-member **16**.

A right pedal **17R** and a left pedal **17L** are connected to either side of the tubular stand **15** by parallel bars

19R, 21R and 19L, 21L respectively. Each pedal has an underlying tab 23, and the bars 19R, 21R and 19L, 21L are pivotally connected to the tab at points 25 and 27 respectively. The other ends of bars 19R, 21R and 19L, 21L are pivotally connected to either side of the tubular member at points 29 and 31 respectively. Accordingly, the steps can be moved upwardly, to an upward position as illustrated in FIG. 1, and downwardly to a downward position when the bars 19R, 21R and 19L, 21L are parallel to stabilizer member 13.

Connected to the right-hand parallel bars 19R, 21R and 19L, 21L are cables or straps 33R, 33L respectively. The straps 33R and 33L are wrapped around rotary members 35R and 35L (see also FIG. 2) which in the present embodiment constitute pulleys. The pulleys 35R and 35L are disposed adjacent spring covers 37R and 37L which, as seen in FIG. 2, house springs 39R and 39L respectively.

As seen in FIG. 2, pulley 35L is concentric with and surrounds a bushing 41. The bushing 41 is connected to the pulley 35L by one-way clutch 43. The one-way clutch will connect the bushing 41 to the pulley 35L when the pulley is rotated by a downward motion of the step 17L, i.e., in a counter-clockwise direction looking at the arrangement in FIG. 2 from the left-hand side.

Bushing 43 is connected to shaft 45 by keyway 47 so that shaft 45 will rotate with bushing 43.

Shaft 45 is connected to the carrier plate 49 of a first planetary gear arrangement by keyway 51 so that carrier plate 49 will rotate with the rotation of the shaft 45. Rotation of carrier plate 49 will cause pinions 53 (of which there are three in the planetary gear arrangement) to rotate, and the teeth of pinions 53 mesh with teeth 55 of the sun gear of the first planetary gear arrangement. The sun gear of the first planetary gear arrangement is connected to a carrier plate 57 of a second planetary gear arrangement which will thereby rotate with the rotation of the pinions 53 of the first planetary gear arrangement. This causes rotation of pinions 59 of the second planetary gear arrangement (which also includes three such pinion gears), and the teeth of the pinion gears 59 mesh with the teeth 61 of the sun gear of the second planetary gear arrangement. The sun gear of the second planetary gear arrangement is connected to a rotary member 63 of a resistance element illustrated generally at 65. In the illustrated embodiment, the resistance element 65 comprises an electromagnetic brake, and the rotary member 63 comprises the armature of the electromagnetic brake, which armature is in the shape of a short cylinder.

It is noted that the pinions 51 and 59 rotate in ring gear 67 which comprises the ring gear for both the first and second planetary gears. Specifically, the teeth of the pinions 51 and 59 mesh with the teeth 69 of the carrier 67. The carrier 67 is fixed to the tubular member 15 by bolt 70.

As is well known in the art, ring gear 67 is cylindrical in shape, and carrier plates 49 and 57 are circular and disposed co-axially with the cylindrical ring 67. The pinion gears are equally spaced around the carrier plates.

The electromagnetic brake comprises a plurality of bobbins 71 equally spaced around a pedestal 73 which comprises a short cylindrical member. The pedestal 73 is fixed to tubular member 15 by bolt 75.

Clutch 77 is disposed between pulley 35R and the right-hand end of the shaft 45. Clutch 77 will engage when downward motion of step 17R causes pulley 35R to rotate, i.e., once again, in the counterclockwise direction as seen from the left-hand side of FIG. 2. When the shaft rotates in the opposite direction, clutch 77 will slip.

Spring 39L is connected to pulley 35L so that the spring will be wound up when the pulley is rotated by the downward movement of step 17L, and will unwind when weight is removed from step 17L in its downward position to rotate pulley 35L in a clockwise direction to raise the step 17L to its upward position. Spring 39R is connected to pulley 35R in the same way. Thus, steps 17L and 17R will be raised from their downward to their upward position by the actions of springs 39L and 39R on pulleys 35L and 35R respectively.

In operation, the apparatus works as follows:

Assuming that the apparatus is in the state illustrated in FIG. 1, and an exerciser steps on step 17L, this will cause pulley 35L to rotate in the direction in which clutch 43 engages so that bushing 41 will rotate with the pulley 35L. Because of the connection between keyway 47 and shaft 45, shaft 45 will also rotate with the rotation of pulley 35L, and because of the connection between keyway 51 and carrier plate 49, carrier plate 49 will also rotate causing pinions 53 to rotate which, in turn, will cause carrier plate 57 to rotate. The rotation of carrier plate 57 will cause pinions 59 of the second planetary gear to rotate and this in turn will cause the armature 63 of the resistance element 65 to rotate. Armature 63 rotates against the braking force of the electromagnetic brake 65 thereby providing exercising resistance for the user.

At the same time, while pulley 35L is rotating, it will cause spring 39L to wind up. Clutch 77 will slip so that pulley 35R does not rotate with the rotation of shaft 45.

When step 17L reaches its downward position, the exerciser will place his foot, and his weight, on the upward step 17R. At this time, his weight will be removed from the step 17L, so that spring 39L will unwind pulling step 17L to its upward position.

When the exerciser steps on step 17R and puts his full weight thereon, then pulley 35R will be rotated by the action of cable 33R. With the pulley rotating in the direction caused by the downward movement of the step 17R, clutch 77 engages so that shaft 45 will rotate with pulley 35R. Again, the shaft 35 will be rotating in a counter-clockwise direction when looked at from the left-hand side in FIG. 2. At this time, clutch 43 will slip so that pulley 35L will not rotate with the rotation of shaft 45.

Once again, rotation of the shaft 45 will cause carrier plate 49 to rotate and, through the same train of action as above described, armature 63 of electromagnetic brake 65 will also rotate.

Accordingly, it can be seen that when a downward force is applied to either step 17L or step 17R, the linear motion will be translated to rotary motion by the respective pulley, and the rotary motion will be transmitted to the armature 63 of the electromagnetic brake 65. The armature will rotate against the braking force of the electromagnetic brake to thereby cause resistance for the exerciser to overcome.

It will also be seen that the pedals act independently of each other in accordance with the teachings of the present invention.

The bobbins 71 comprise mandrels with a single wire wound therearound. Both ends of the wires of all of the bobbins are connected, in parallel, to a source of current, and the magnitude of resistance offered by the inventive apparatus can be varied by varying the current applied to the bobbins. As is well known, varying the current will vary the magnetic field which causes the braking action.

The current will be made variable by activating appropriate switches of a control panel **79** illustrated in FIG. **1**. The control panel would also include a read-out indicator to indicate, amongst other things, the resistance at which the apparatus is presently set. Other read-outs, as is well known in the art, can also be presented on the control panel.

As is well known in the art, the purpose for using a planetary gear arrangement is to provide an increase in rotary speed. Thus, the rotary speed of armature **63** will be greater than the rotary speed of pulleys **35R** or **35L** which causes the armature **63** to rotate. In the present embodiment, two carrier plates are illustrated. However, as is quite apparent, teeth **61** could be disposed to engage with the teeth of pinion gears **53** so that a second carrier plate would not be needed. Alternatively, the planetary gear arrangement could include three carrier plates if such an increase in speed is required.

In addition, although in the preferred embodiment there is a bushing **41** between pulley **35L** and shaft **45**, and contact between pulley **35R** and shaft **45** is direct (through clutch **77**), obviously, there could be bushings at both ends of the shaft, or there could be direct contact between the pulleys and the shaft at both ends. Again, the bushing could be placed at the righthand end and the left-hand end could include direct contact between pulley **35L** and the left-hand end of the shaft **45**.

Although a particular embodiment has been described, this was for the purpose of illustrating, but not limiting, the invention. Various modifications, which will come readily to the mind of one skilled in the art, are within the scope of the invention as defined in the appended claims.

I claim:

1. A stair climbing exercise apparatus, comprising:

a frame structure;

a first step and a side-by-side second step, said steps being pivotally connected to said frame structure for up-and-down motion thereof;

a first rotary member mounted on said frame structure adjacent said first step and a second rotary member mounted on said frame structure adjacent said second step;

a first strap means having one end connected to said first step and the other end connected to said first rotary member whereby, when said first step is moved from an upward to a downward position, said first rotary member is caused to rotate in one direction;

a second strap means having one end connected to said second step and the other end connected to said second rotary member whereby, when said second step is moved from an upward to a downward position, said second rotary member is caused to rate in said one direction;

shaft means extending between said first rotary member and said second rotary member;

first connecting means connecting said first rotary member one end of said shaft means such that said shaft means rotates with said first rotary member when said first rotary member rotates in said one direction and does not rotate with said first rotary member when said first rotary member rotates in an opposite direction;

second connecting means connecting said second rotary member to the other end of said shaft means such that said shaft means rotates with said second rotary member when said second rotary member rotates in said one direction and does not rotate with said second rotary member when said second rotary member rotates in said opposite direction;

an exercise resistance element;

a planetary gear arrangement for transmitting rotation of said shaft means to said resistance element such that the rotary speed of said resistance element is greater than the rotary speed of said shaft means.

2. An apparatus as defined in claim **1** and including first spring means for returning said first step to an upward position, and second spring means for returning said second step to an upward position.

3. An apparatus as defined in claim **2** wherein said first rotary member comprises a first pulley and wherein said second rotary member comprises a second pulley.

4. An apparatus as defined in claim **3** wherein said first connecting means comprises a bushing connected to said one end of said shaft by a keyway;

said first pulley being connected to said bushing by a first one-way clutch.

5. An apparatus as defined in claim **4** wherein said resistance element comprises an electromagnetic brake having a rotatable armature.

6. An apparatus as defined in claim **5** wherein said planetary gear arrangement comprises;

a ring gear, said ring gear being fixedly connected to said frame structure, said ring gear comprising a cylindrical element having gear teeth on the inner surface thereof;

carrier means comprising a circular carrier plate carrying a plurality of pinion gears, the teeth of the pinion gears meshing with the teeth of said ring gear, said carrier means being rotatable with said shaft means; and

said armature comprising gear teeth, said gear teeth of said armature meshing with said gear teeth of said pinion gears;

whereby, said armature rotates with said shaft so that said armature rotates with the rotation of said first pulley in said one direction or with the rotation of said second pulley in said one direction.

7. An apparatus as defined in claim **6** wherein said carrier means comprises;

a first carrier plate and a second carrier plate, said carrier plates being disposed in parallel and co-axial arrangement;

said first carrier plate comprising a plurality of equally spaced first pinion gears;

said second carrier plate comprising gear teeth at one end thereof and carrying a plurality of second pinion gears;

the gear teeth of said first pinion gears meshing with the gear teeth of said second carrier plate; and

the gear teeth of said second pinion gears meshing with the gear teeth of said armature.

8. An apparatus as defined in claim **7** wherein said armature of said electromagnetic brake comprises a short cylinder disposed parallel to said carrier plates and co-axial therewith;

a circular pedestal mounted within said armature and co-axial therewith; and

a plurality of bobbins equally spaced around said pedestal.

9. An apparatus as defined in claim 8 wherein said second connecting means comprises a second one-way clutch between the second end of said shaft means and said second pulley.

10. An apparatus as defined in claim 9 wherein said first spring is connected to said first pulley such that said first spring winds up when said first pulley is rotated in said one direction, and wherein, when said spring unwinds, it rotates said pulley in said opposite direction;

and wherein said second spring is connected to said second pulley such that said second spring winds up when said second pulley is rotated in said one direction, and wherein, when said spring unwinds, it rotates said pulley in said opposite direction.

* * * * *

United States Patent [19]

Melton et al.

[11] **Patent Number:** **4,542,897**

[45] **Date of Patent:** **Sep. 24, 1985**

[54] **EXERCISE CYCLE WITH INTERACTIVE AMUSEMENT DEVICE**

[76] Inventors: **Donald L. Melton,** 14722 Oak Pine, Houston, Tex. 77040; **William L. Thomas, III,** 10815 Cypresswood, Houston, Tex. 77070

[21] Appl. No.: **540,290**

[22] Filed: **Oct. 11, 1983**

[51] **Int. Cl.**[4] **A63B 21/00**

[52] **U.S. Cl.** **272/73;** 272/132; 272/DIG. 5; 272/DIG. 6; 128/668; 273/DIG. 28

[58] **Field of Search** .... 272/69, 72, 73, 76, 272/78, 96; 280/289 D, 289 H; 273/DIG. 28, 1 E, 85 G; 128/668

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Primary Examiner—Richard C. Pinkham
Assistant Examiner—MaryAnn Stoll Lastova
Attorney, Agent, or Firm—Neal J. Mosely

[57] **ABSTRACT**

An exercycle combined with a video game computer and game control allows the physical effort of the operator to generate electrical current for operation of the game control permitting the operator to control and interact with the computer upon maintaining a predetermined level of physical effort. Although the computer is activated by a separate power source, the generator, upon attainment of a predetermined energy expenditure level, activates the computer game. The apparatus provides amusement and an incentive to perform monotonous exercise routines as well as developing mental and manual coordination skills simultaneously with physical development.

20 Claims, 7 Drawing Figures

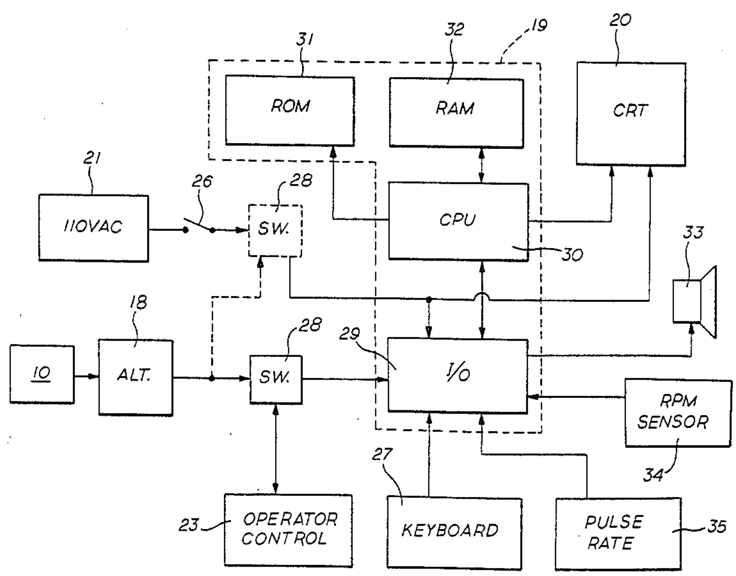


fig.1

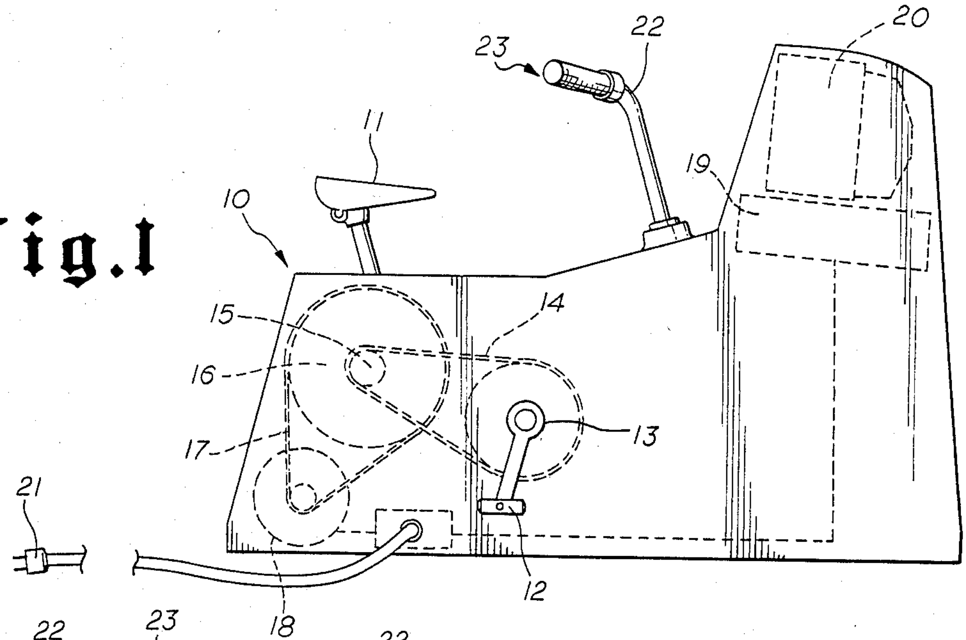


fig.2

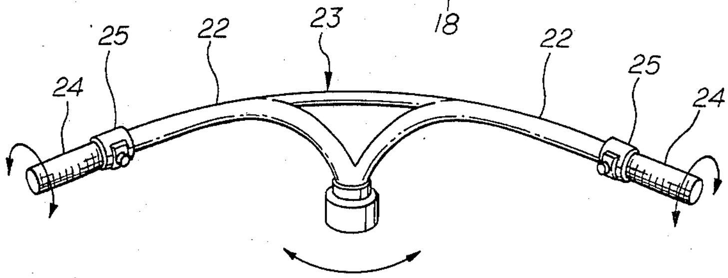
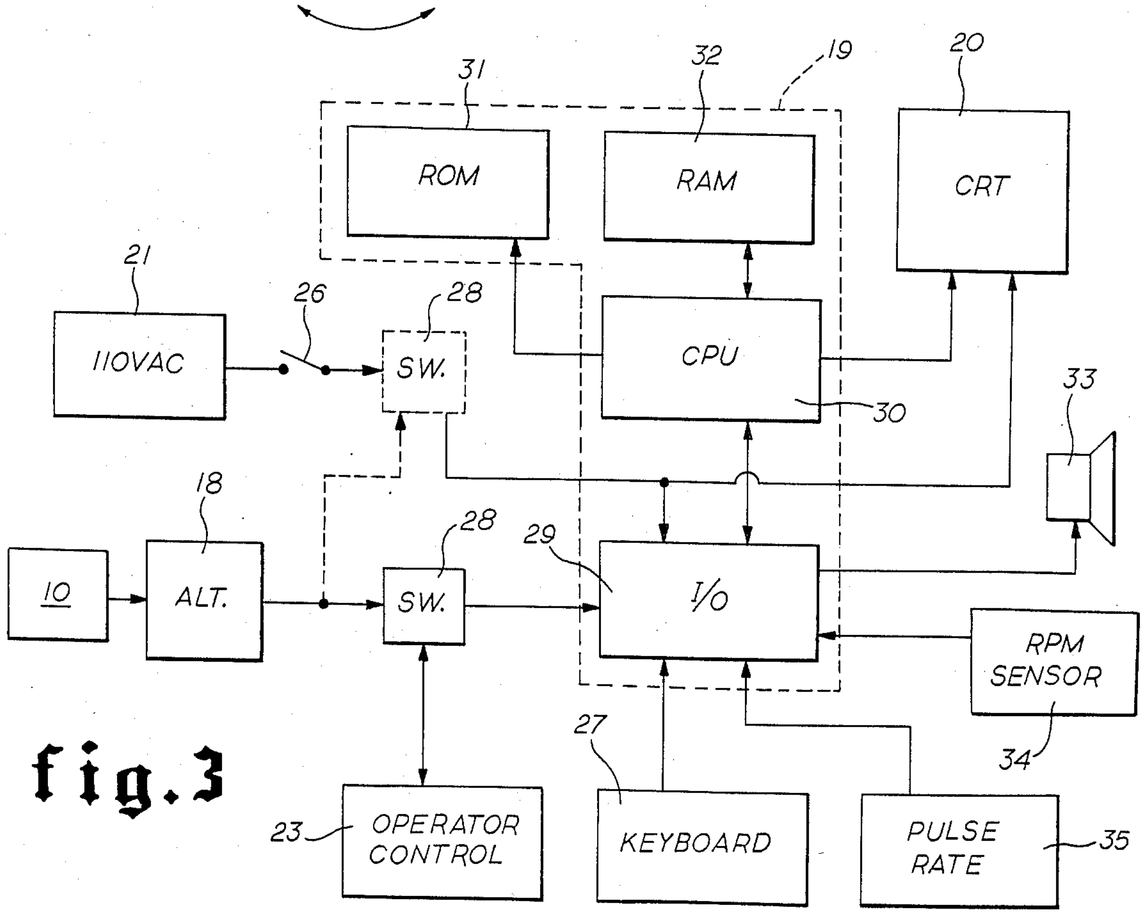
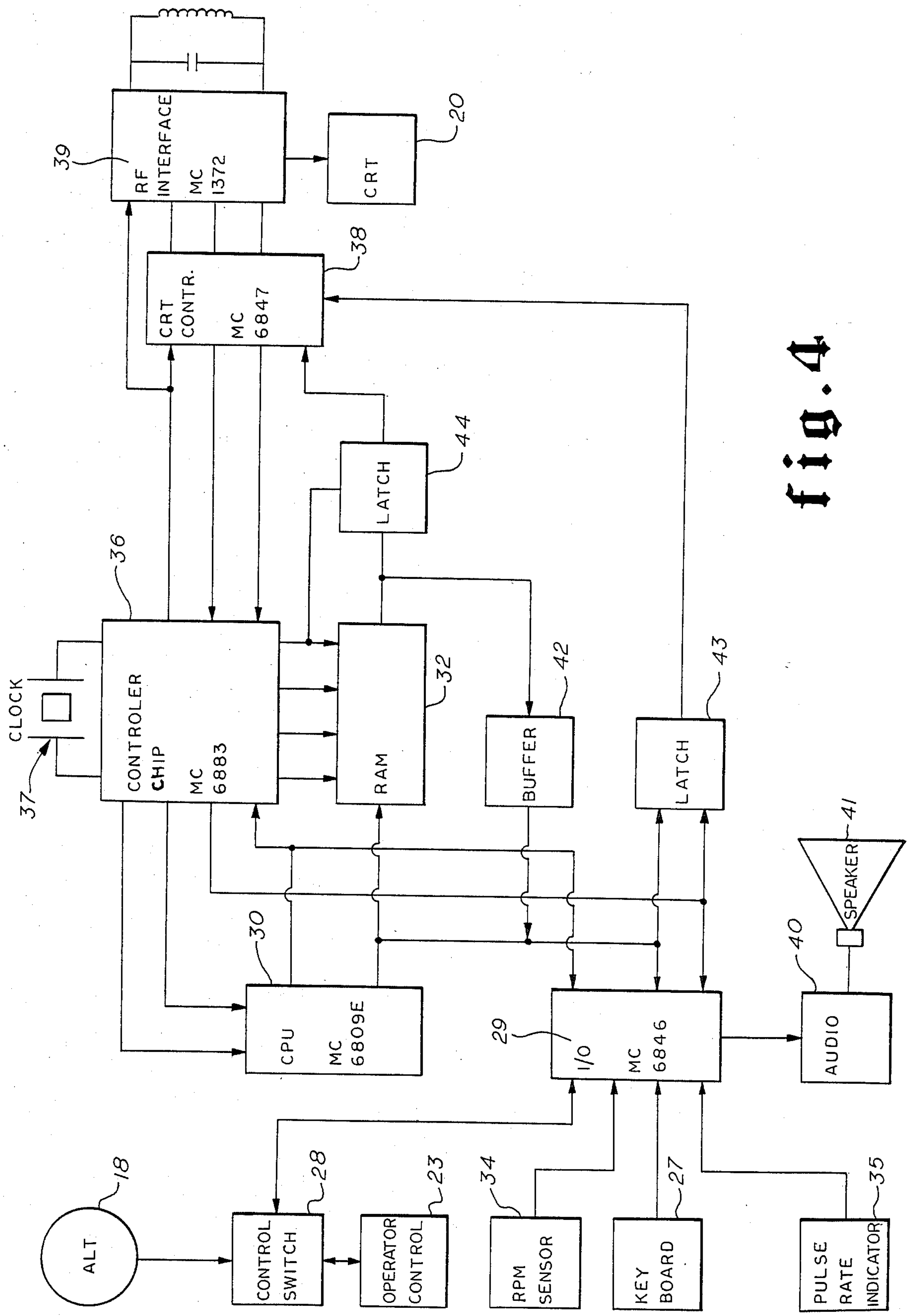


fig.3

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39
CRT
20
CRT CONTR. MC 6847
38
LATCH
44
CONTROLER CHIP MC 6883
36
CLOCK
37
RAM
32
BUFFER
42
LATCH
43
SPEAKER
41
CPU MC 6809E
30
I/O MC 6846
29
AUDIO
40
ALT
18
CONTROL SWITCH
28
OPERATOR CONTROL
23
RPM SENSOR
34
KEY BOARD
27
PULSE RATE INDICATOR
35

fig. 4

APPENDIX JJ

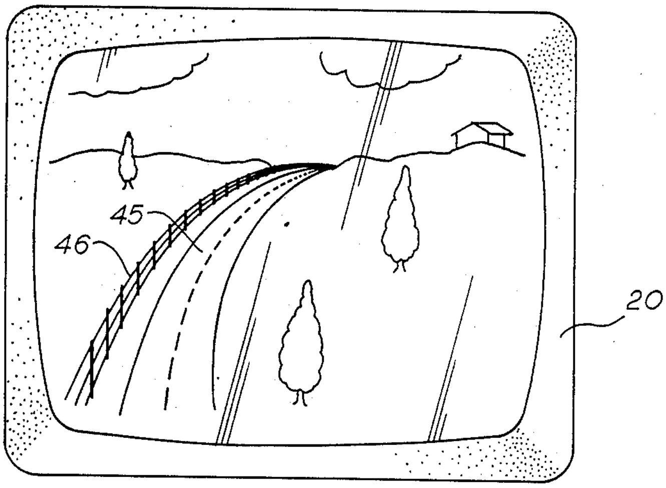

fig. 5

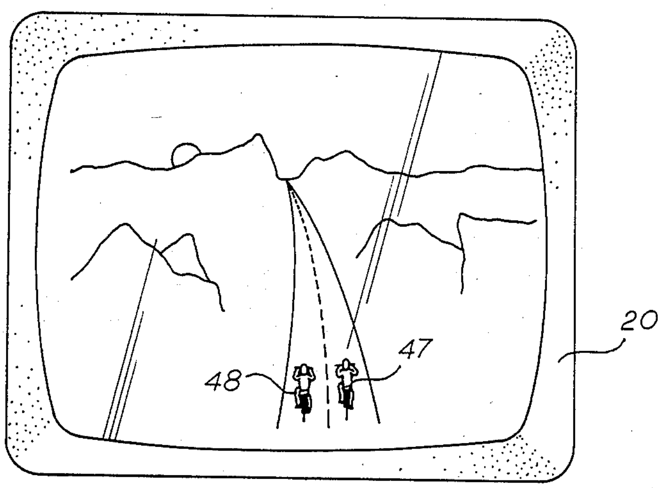

fig. 6

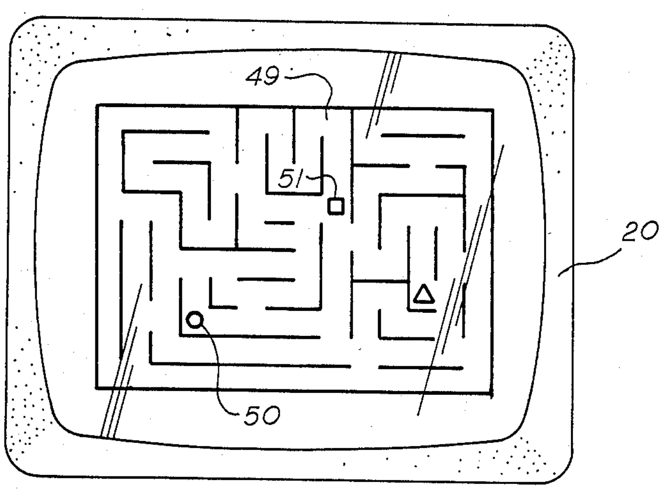

fig. 7

EXERCISE CYCLE WITH INTERACTIVE AMUSEMENT DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to exercise apparatus, and more particularly to a cycle type exerciser, combined with a video game or computer for providing amusement and an incentive to perform monotonous exercise routines as well as developing mental and manual coordination skills simultaneously with physical development.

2. Brief Description of the Prior Art

Using a bicycle or exercise cycle as a means of powering an amusement device or television set is known in the prior art. There are several patents which disclose bicycles and exercise cycles in combination with various amusement and video devices.

Stern, U.S. Pat. No. 3,210,634 discloses a bicycle for driving a generator.

Mullen, U.S. Pat. No. 1,653,921 discloses an amusement device mechanically and electrically coupled to an exercise bicycle.

Bisberg, U.S. Pat. No. 3,903,613 discloses an exercise bicycle with a tape playback unit, stereo and or video projector coupled to the equipment.

Sweeney, U.S. Pat. No. 4,358,105 discloses a programmed computer with displays attached to an exercise bicycle.

Lapeyre, U.S. Pat. No. 4,278,095 discloses a television monitor controlled by an exercise treadmill.

Emmons, U.S. Pat. No. 4,141,630 discloses an exercise bicycle with a projector arrangement for showing distance indicating pictures.

Barron, U.S. Pat. No. 3,984,666 discloses an exercise bicycle having a calorie consumption indicator.

Holmes, U.S. Pat. No. 4,298,893 discloses an exercise bicycle which powers a television set.

The prior art in general, and none of these patents in particular, is concerned with the combination of an exercise cycle with a video game computer and game control where the physical effort of the operator generates the electric current for operating the game control, thus permitting the operator to control and interact with the computer to provide amusement and an incentive to perform monotonous exercise routines as well as developing mental and manual coordination skills simultaneously with physical development.

The standard electronics notation used herein and the specifications for various standard components are found in the literature, e.g. ELECTRONICS FOR THE MODERN SCIENTIST, P. B. Brown et al., Elsevier Science Publishing Co., Inc., 1982; ENCYCLOPEDIA OF COMPUTER SCIENCE AND ENGINEERING, 2nd ED., Van Nostrand Reinhold Co., Inc., 1983; ENCYCLOPEDIA OF INTEGRATED CIRCUITS, W. H. Buchman, Prentice-Hall Inc., 1981.

SUMMARY OF THE INVENTION

One object of the invention is to provide an exercise cycle cooperative with a video game computer having means whereby the operator may control and interact with the computer upon maintaining a predetermined level of physical effort.

Another object of this invention is to provide an exercise cycle having a video game computer and video

display powered independently of the electrical current generated by the physical effort of the operator.

Another object of this invention is to provide an exercise cycle which will simultaneously develop mental and manual coordination skills with physical exercise.

Another object of this invention is to provide an exercise cycle which will reduce boredom by providing amusement during monotonous exercise routines.

Another object of this invention is to provide an exercise cycle wherein the operator may selectively choose the form of amusement to maintain an interest in the routine exercise program.

Other objects of the invention will become apparent from time to time throughout the specification and claims as hereinafter related.

The above noted objects and other objects of the invention are accomplished by an exercycle combined with a video game computer and game control which allows the physical effort of the operator to generate electric current for operation of the game control permitting the operator to control and interact with the computer upon maintaining a predetermined level of physical effort. The apparatus provides amusement and an incentive to perform monotonous exercise routines as well as developing mental and manual coordination skills simultaneously with physical development.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevation view of an exercise apparatus, i.e. exercycle, having electrical power generating means and operator control means coupled with a video game computer.

FIG. **2** is a perspective view of the operator game control means.

FIG. **3** is a logic diagram of the system.

FIG. **4** is an electronic diagram of the computer and peripherals of the system.

FIG. **5** is a view of a CRT screen illustrating one example of an amusement or game controlled or operated by the apparatus.

FIG. **6** is a view of a CRT screen illustrating an example of an amusement or game controlled or operated by the apparatus in which a competitive action is utilized.

FIG. **7** is a view of a CRT screen illustrating an example of an amusement or game controlled or operated by the apparatus in which there is an interaction by the operator.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings by numerals of reference, there is shown in FIG. **1** a cycle type exercise apparatus **10**. Although the apparatus used in the preferred embodiment is a cycle type, it should be understood that other types of exercise apparatus may be incorporated without departing from the scope of the present invention.

The cycle exercise apparatus **10** has the usual seat **11**, pedals **12**, and a pedal sprocket **13** connected by a chain **14** to a smaller sprocket **15** attached to a flywheel **16**. The flywheel **16** is connected to suitable conventional means (not shown) for applying variable rotational resistance to the flywheel **16** for controlllng the effort required to operate the apparatus **10**. A second chain **17** connects the flywheel **16** to an alternator **18** to provide an electrical current for operating equipment associated with the exercise apparatus.

A video game computer **19** and a video display screen **20** are provided on exercise apparatus **10** and are powered by 110 V. AC. supplied by plug **21** when connected to a conventional electric outlet. The video game computer **19** and video display **20** are combined as an integral part of the apparatus **10** but may be separate units located apart from the apparatus, if desired.

Handlebars 22 (FIG. 2) provide the operator with video game control means **23** whereby the operator may control and interact with the video display **20**. The handlebars **22** are rotatable to provide a horizontal control signal, and the hand grips **24** rotatable to provide a vertical control signal or speed control (depending upon the program used in the game computer). Two hand grips are provided so that left and right handed operators have the same advantage, or an operator may want to develop dexterity in his weaker side. A fire button **25** is provided adjacent to the hand grips **24** for interaction such as firing missiles, dropping bombs, etc. The handlebars **22**, hand grips **24**, and fire button **25** cooperate to provide the operator with control of the game action in the same manner as the popular joystick type game controllers. The electronic circuitry contained in the handlebars **22**, hand grips **24**, and fire buttons **25**, is conventional and obvious to those skilled in the art and is therefore shown only schematically.

The logic diagram of the system is shown in FIG. **3**. An on-off switch **26** is provided to activate the computer **19** and the video display or CRT **20** and to load a program or game cartridge into the computer **19**. A keyboard **27** is provided in the system for entering specially designed programs. The program may be one specifically designed for an exercise routine, may be a conventional video game cartridge, or the operator may type in a program from keyboard **27**. When switch **26** is closed, the computer **19** and the CRT **20** are operational.

Alternator **18** is connected to switch **28**, which is connected to the game control means **23**. The input-output or I/O component **29** is interposed between switch **28** and the CPU **30** of computer **19**. Computer **19** and video display screen or CRT **20** are connected to receive their power from a 110 V. AC source independent of the current generated by the alternator **18**.

The I/O component **29** is connected to a central processing unit or CPU **30**. The CPU **30** is provided with a data control program stored in a read only memory or ROM chip **31**. Program data, such as a game or exercise program is loaded into the CPU **30** through a random access memory, or ROM chip **32**. Output data from the CPU **30** is produced visually on the CRT **20** and audibly on the audio component or speaker **33**. The I/O component **29** can optionally be interfaced with various additional data gathering means, including RPM sensor **34**, a pulse rate indicator **35**, and/or a keyboard **27**. The operator can thereby interact or compete with other operators with the additional input information.

Alternatively, the switch **28** may be connected between the on-off switch **26** and the I/O component **29** (shown in dotted line) so that the operators efforts are required to activate the switch **28** allowing the independent 110 V. AC source to power the complete system and thus prevent damage to the computer **19** or the programs by prolonged usage.

FIG. **4** shows the electronic circuitry of the system. Alternator **18** is connected to activate control switch **28** which establishes communication between the game control means **23** and I/O ROM chip **29** such as an MC 6846. Other data gathering means such as an RPM sensor **34**, a programmable keyboard **27**, and a pulse rate indicator **35**, are interfaced with the I/O chip **29**.

The I/O chip **29** communicates with a controller chip **36**, such as an MC 6883, which is interfaced with a microprocessor (CPU) chip **30**, such as an MC 6809E. In conjunction with a pulse generated by the clock **37**, the controller chip **36** receives and transmits data between the I/O chip **29**, gathers data from the RAM chip **32** and transmits it to the microprocessor chip **30**. The microprocessor chip **30** in conjunction with the incoming programmed data in the I/O ROM chip **29** and the signal sent by the controller chip **36** will process the data and transmit it to the appropriate output component.

Video output data is transmitted through the controller chip **36** to a CRT controller chip **38** such as an MC 6847. Video output data in digital format is converted to an analog signal by an RF interface chip **39**, such as an MC 1372. The converted signal is transmitted by coaxial cable to the CRT monitor **20** to produce a visual display of the data. The microprocessor **30** will send an audio signal to the audio decoder **40** through the I/O ROM chip **29** when determined by the processed data. The audio decoder **40** converts the digital formatted signal to an analog signal, amplifies it, and transmits it to the speaker **41**.

Buffer **42** is interfaced with RAM chip **32** and the microprocessor **30**. Latch **43** is interfaced with I/O ROM chip **29** and the CRT controller chip **38**. Latch **44** is interfaced with controller **36**, RAM chip **32**, and CRT controller **38**.

In FIGS. **5**–**7**, there are shown three different examples of the types of amusement or game activity which may be displayed on the screen of the CRT **20**. In FIG. **5**, CRT **20** displays a scene of a road **45** extending from front to back of the screen in perspective. On each side of road **45** scenery **46**, i.e. telephone poles, is depicted which is moved relative to the road to give the illusion of forward motion. The apparatus can be set to give a competitive action by the operator corresponding to a race against time with the CRT **20** indicating the rate of speed. This provides amusement and a standard of performance against which the operator can compete.

In FIG. **6**, CRT **20** displays a scene of a road **45** extending from front to back of the screen in perspective. On each side of road **45** scenery **46**, i.e. telephone poles, is depicted which is moved relative to the road to give the illusion of forward motion. The road **45** illustrated on the CRT **20** has one cyclist **47** which is programmed to race at a predetermined speed. A second cyclist **48** is shown which corresponds to the operator and moves along the screen at a variable rate of speed determined by the input from the apparatus. The apparatus is therefore set to give a competitive action by the operator corresponding to a race against cyclist **47**. This apparatus may be connected to an adjacent machine to interact and compete with another operator. This provides amusement and a standard of performance against which the operator can compete.

In FIG. **7**, CRT **20** displays a maze **49** which is exemplary of a variety of types of video arcade games. The maze **49** includes one contestant or character **50** which is hostile and moves according to a preset program. There is another contestant or character **51** which moves according to the input from the apparatus by the operator. This embodiment operates in the same manner as various conventional video arcade games but the input by the operator is determined by a selected level of performance on the exercise apparatus.

OPERATION

The operation of the apparatus should be apparent from the description of the construction and assembly but will be described in more detail for a fuller understanding of the invention.

The operator turns on the on-off switch **26** to activate the computer **19** and the video display or CRT **20**, loads a program or game cartridge into the computer **19**. The program may be specifically designed for an exercise routine, a conventional video game cartridge, or the operator may type in a program from a keyboard **27**. At this time the computer **19** and the CRT **20** are operational and may be instructing or prompting the operator, or the display may be advertising the program, should the exercise apparatus be in commercial use in a spa.

The operator mounts the exercise apparatus **10**, selects the level of effort desired, and turns the pedals **12**. The rotational force of the pedals **12** is transmitted to the flywheel **16** and then to the alternator **18** which generates an electrical current to activate a switch **28**. When the current generated by the alternator **18** reaches the predetermined level, the switch **28** closes a circuit allowing the game control means **23** to communicate with the input-output or I/O component **29** of the computer **19**.

Computer **19** and video display screen or CRT **20** receive their power from a 110 V. AC source independent of the current generated by the alternator **18**. The I/O component **29** is connected to a central processing unit or CPU **30**. The CPU **30** is provided with a data control program stored in a read only memory or ROM chip **31**. Program data, such as a game or exercise program is loaded into the CPU **30** through a random access memory, or RAM chip **32**. Output data from the CPU **30** is produced visually the CRT **20** and audibly on the audio component **33**. The I/O component **29** is interfaced with various additional data gathering means, such as an RPM sensor **34**, a pulse rate indicator **35**, and/or a keyboard **27**. The operator can thereby interact or compete with other operators with the additional input information.

In contrast with prior art exercise apparatus in which the effort of the operator merely supplies the power for the video, the present invention provides an independent source of power to the computer **19** and CRT **20**, however the operator cannot control or interact with the computer **19** or CRT **20** until his efforts reach a predetermined level and allow the game control means **23** to become operational. This allows the operator to stop exercising without losing the data stored in the computer memory, and allows the computer **19** or CRT **20** to prompt the operator to continue. It also allows one operator to dismount and another operator to mount the apparatus **10** and compete with the first without having to restart the game or exercise routine.

In the embodiment of FIG. **5**, CRT **20** displays a scene of a road **45** extending from front to back of the screen in perspective. On each side of road **45** scenery **46**, i.e. telephone poles, is depicted which is moved relative to the road to give the illusion of forward motion. The input by the operator gives a competitive action on CRT **20** corresponding to a race against time. This provides amusement and a standard of performance against which the operator can compete. In the embodiment of FIG. **6**, CRT **20** displays a scene of a road **45** extending from front to back of the screen in perspective. On each side of road **45** scenery **46**, i.e. telephone poles, is depicted which is moved relative to the road to give the illusion of forward motion. The road **45** illustrated on the CRT **20** has one cyclist **47** which is programmed to race at a predetermined speed. A second cyclist **48** is shown which corresponds to the operator and moves along the screen at a variable rate of speed determined by the input from the apparatus. The apparatus is therefore set to give a competitive action by the operator corresponding to a race against cyclist **47**. This provides amusement and a standard of performance against which the operator can compete.

In the embodiment of FIG. 7, CRT **20** displays a maze **49** which is exemplary of a variety of types of video arcade games. The maze **49** includes one contestant or character **50** which is hostile and moves according to a preset program. There is another contestant or character **51** which moves according to the input from the apparatus by the operator. The control of the second character by the operator is effected by control mechanism **23** and the separate controls **24** and **25** which give a type of control similar to the joy stick control of a conventional arcade type game. This embodiment operates in the same manner as various conventional video arcade games but the input by the operator is determined by a selected level of performance on the exercise apparatus which determines when the main control switch **28** is activated.

While this invention has been described fully and completely with special emphasis upon a preferred embodiment, it should be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described herein.

We claim:

1. The combination of stationary-mounted, pedal-operated exercise apparatus with a computer operated video display apparatus which provides operator interaction with a computer during an exercise program, comprising;

- a pedal operated exercise apparatus mounted in a fixed position on a stationary surface for use in exercising by an operator by pedaling in a fixed position,
- an electric generator operated by said pedal operated apparatus,
- switch means connected to said generator and activated upon a predetermined output from said generator corresponding to a predetermined energy expenditure level by the operator of said exercise apparatus,
- a computer having a power source independent from said generator,
- a video display interfaced with said computer and having a power source independent from said generator,
- means on said exercise apparatus controlled and operated by the operator for interactively playing a game on said computer, and
- said switch means being operatively distinct from said operator-controlled means and connected in circuit between said computer and said operator-controlled means and permitting game playing on said computer only when said switch means is activated by said generator.

2. The apparatus combination according to claim **1** including

data gathering means interfaced with said computer for monitoring the condition of the operator or the apparatus.

3. The apparatus combination according to claim **2** wherein

said data gathering means comprises an RPM sensor means to determine the operator energy expenditure level.

4. The apparatus combination according to claim **2** wherein

said data gathering means comprises a pulse rate indicator to determine the operator energy expenditure level.

5. The apparatus combination according to claim **1** wherein

said switch means is interposed between the independent power source and said computer and video display.

6. The apparatus combination according to claim **1** wherein

said switch means remains activated only as long as the predetermined operator energy expenditure level is maintained.

7. The apparatus combination according to claim **1** wherein

said generator comprises an alternator.

8. The apparatus combination according to claim **1** wherein

said computer is positioned in a fixed position remote from said exercise apparatus.

9. The apparatus combination according to claim **1** wherein

said video display is positioned in a fixed position remote from said exercise apparatus.

10. The apparatus combination according to claim **1** wherein

said operator-controlled means comprises a movable handlebar assembly.

11. The apparatus combination according to claim **1** wherein

said operator-controlled means comprises a programmable keyboard.

12. The apparatus combination according to claim **1** wherein

said computer is programmed to produce a visual display on said video display providing amusement and recreation in a fixed position in view of the operator while said exercise apparatus is operated at a predetermined rate.

13. The apparatus combination according to claim **1** wherein

said computer is programmed to produce a visual competitive game display on said video display providing competitive recreation in a fixed position in view of the operator while said exercise apparatus is operated at a predetermined rate.

14. The apparatus combination according to claim **13** wherein

said video display comprises a moving scene simulating a competition by the operator against time while said exercise apparatus is operated at not less than a predetermined rate.

15. The apparatus combination according to claim **13** wherein

said computer is programmed to produce a visual display on said video display comprising a competitive game operable only while said exercise apparatus is operated at not less than a predetermined rate.

16. The apparatus combination according to claim **15** wherein

said competitive game comprises a game modified by operation of said operator-controlled means.

17. The apparatus combination according to claim **16** wherein

said operator-controlled means comprises a movable handlebar assembly.

18. The apparatus combination according to claim **17** wherein

said handlebar assembly includes a plurality of switches controlling signal inputs to said computer.

19. The apparatus combination according to claim **15** wherein

said operator-controlled means comprises a programmable keyboard.

20. The apparatus combination according to claim **15** wherein

said operator-controlled means comprises a programmable keyboard, and

a movable handlebar assembly including a plurality of switches controlling signal inputs to said computer.

* * * * *

United States Patent [19]

Leask

[11] **Patent Number: 5,031,900**

[45] **Date of Patent: Jul. 16, 1991**

[54] **EDDY CURRENT BRAKING SYSTEM**

[75] Inventor: **John C. Leask,** Mason, N.H.

[73] Assignee: **Engineering Dynamics Corporation,** Lowell, Mass.

[21] Appl. No.: **460,756**

[22] Filed: **Jan. 4, 1990**

[51] **Int. Cl.**[5] **A63B 21/00**

[52] **U.S. Cl.** **272/73; 272/129**

[58] **Field of Search** 272/73, 129; 335/209-211, 296, 297; 188/161, 164; 364/152

[56] **References Cited**

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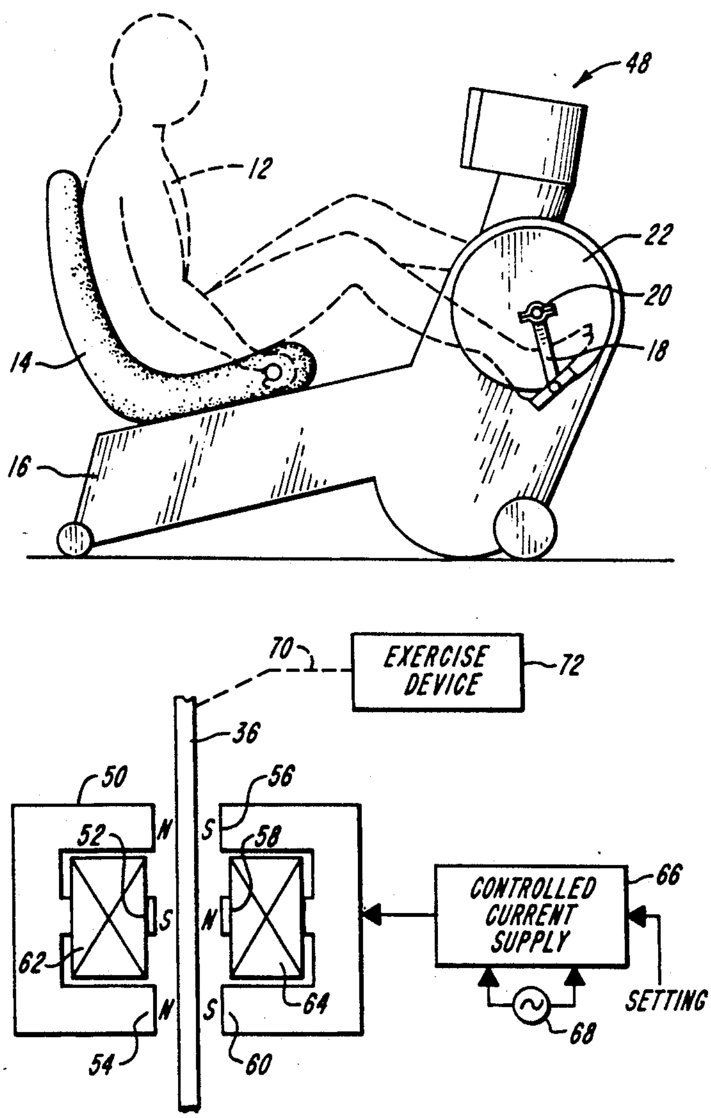
Primary Examiner—Stephen R. Crow
Attorney, Agent, or Firm—Robert K. Tendler

[57] **ABSTRACT**

An improved eddy current braking system for fly wheel braked exercise equipment includes the use of a flat aluminum disc and electromagnets to either side of the disc adjacent to the periphery thereof, with the electromagnets containing multiple pole pieces to multiply the torque so as to reduce heating and power consumption. The utilization of aluminum achieves a flat torque versus speed characteristic vis-a-vis copper discs over the normal operating speed range. Additionally, the utilization of aluminum prevents the warpage associated with copper.

5 Claims, 2 Drawing Sheets



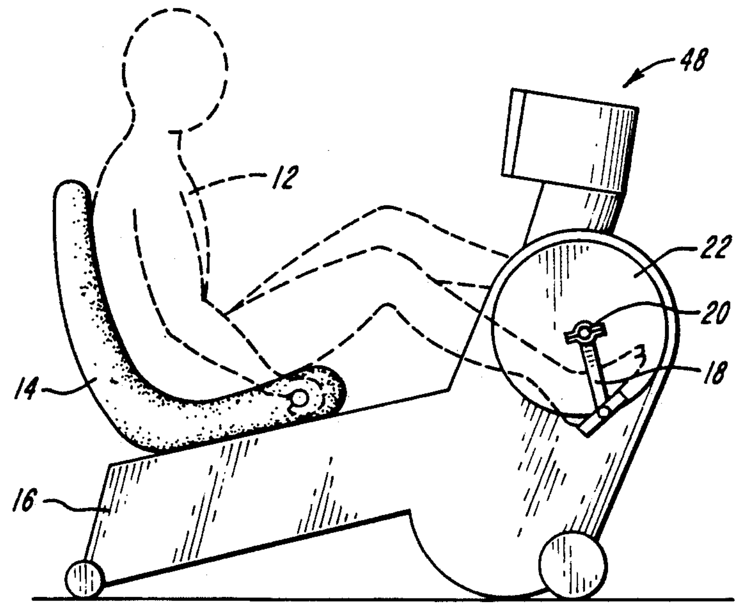
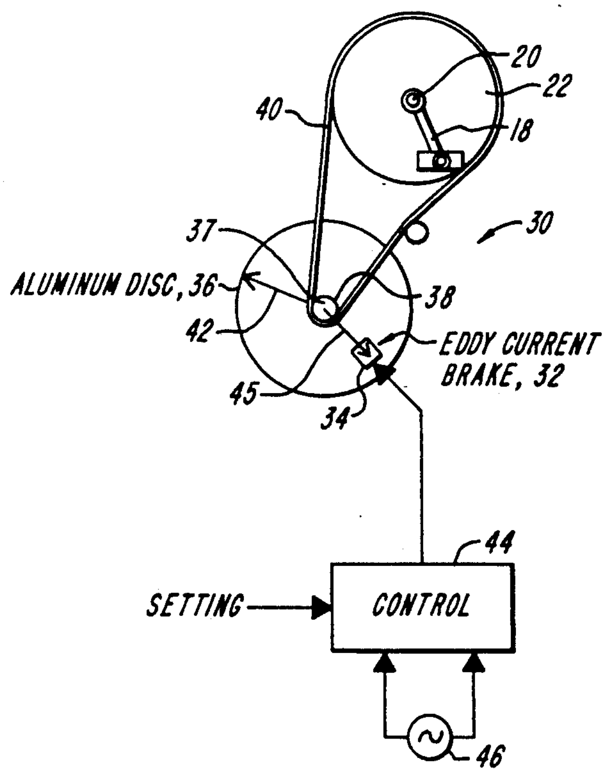

48
12
22
20
18
14
16

FIG. 1


20
22
40
18
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38
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EDDY CURRENT
BRAKE, 32
45
34
44
SETTING
CONTROL
46

FIG. 2

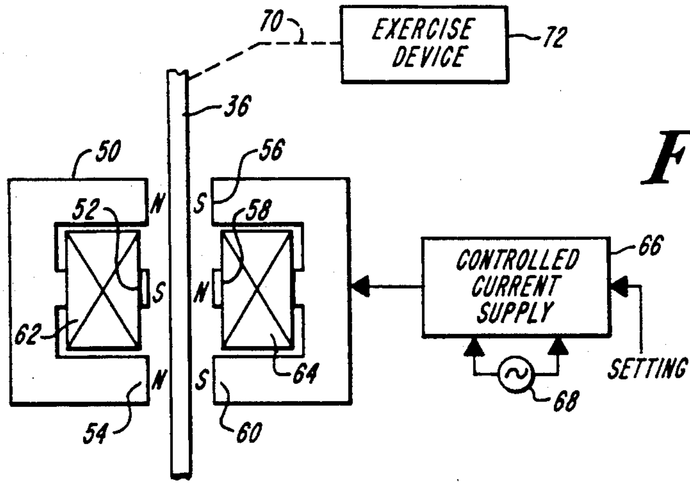

FIG. 3

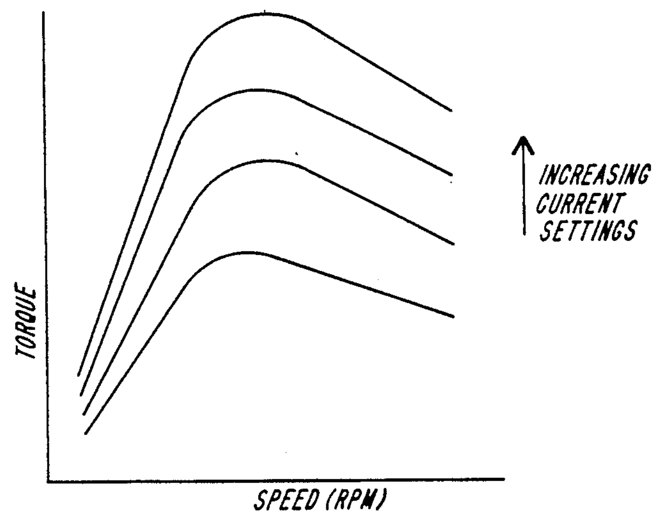

FIG. 4
(PRIOR ART)

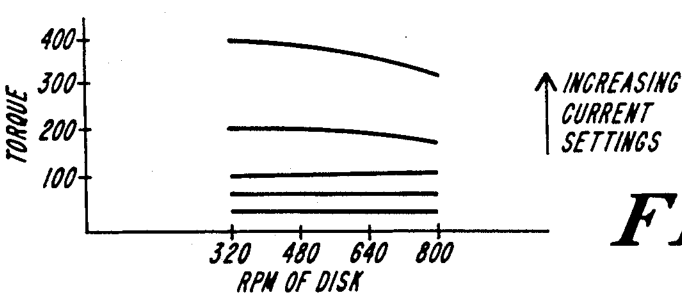

FIG. 5

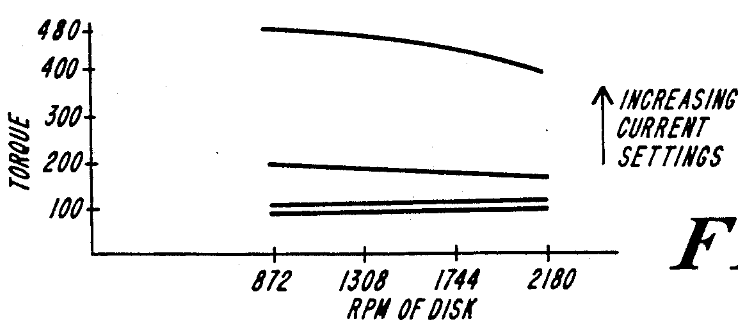

FIG. 6

EDDY CURRENT BRAKING SYSTEM

FIELD OF INVENTION

This invention relates to exercise apparatus and more particularly to an eddy current brake for providing a constant torque for the exercise apparatus.

BACKGROUND OF THE INVENTION

Exercise devices are known in which exercise causes rotary motion of a member, with the rotary motion being opposed by various braking mechanisms. Typical of rowing or bicycling apparatus is a friction brake which applies a frictional retarding force to a fly wheel. One of the major problems with such a braking system is the so called break away torque necessary to start the fly wheel in motion at the beginning of the exercise. Note, an unusual amount of user force is necessary in order to overcome this break away torque, which makes exercise uncomfortable. Typical friction braking devices are described in U.S. Pat. Nos. 1,974,445; 2,725,231; and 2,512,911. Friction brake devices are also described in the following publication: "A constant-torque brake for use in bicycle and other ergometers," J. Y. Harrison J. App. Phys. Vol. 23, No. 6, Dec. 1967.

Electromagnetic braking systems have also been utilized in exercise equipment, the most common of which being an alternator which provides a retarding force against which the user exercises. Such devices are illustrated by U.S. Pat. Nos. 857,447; 3,442,131; 3,555,326; 4,060,239; 4,082,267 and 4,084,810. Other brakes for exercise apparatus are shown in U.S. Pat. Nos. 625,905; 683,124; 782,010, 783,769; 1,239,077; 3,497,215; 3,558,130; 3,586,322; 3,592,466; 3,711,812; 3,765,245; 3,962,595; 4,047,715; 4,085,344; 4,112,928; 4,130,014; 4,298,893; 4,347,993; 4,350,913; 4,396,188; 4,416,293; 4,512,566; 4,687,195; 4,708,338; and 4,798,378. Various foreign patents showing exercise equipment include SU 869,781; DT 2,830-691; GER 743,133; IT 468,973; SW 7706-583; SU 371,950; and DEN. 83817.

Of particular interest are ferromagnetic eddy current type braking systems in which the pole faces of the electromagnets are placed outside a ferromagnetic rim of the fly wheel employed. One of the major problems with such a device is the break away torque due to residual magnetism. Moreover, due to the placement of the electromagnetic pole faces outside the fly wheel, when the fly wheel is heated due to the braking process, the wheel expands and binds against the pole pieces. An additional problem with such expansion is that the expansion is in a direction which varies the gap between the rim of the fly wheel and the pole piece. The result is that due to thermal expansion, an increasing torque is applied, with the relationship between the expansion and the additional torque being non-linear. Such a ferrous metal eddy current brake is shown in U.S. Pat. No. 4,798,378 in which a ferrous rim is placed opposite a stationary electromagnet.

By way of further background, as illustrated in an article entitled "A Bicycle Ergometer with Electric Brake," by Frances G. Benedict and Walter C. Cady in the Carnegie Institution of Washington Journal in 1912, a bicycle ergometer is proposed in which a copper disc is positioned between the pole pieces of electromagnets with the pole pieces being on diametrically opposite sides of the copper disc. While the system described by Benedict et. al. produces an eddy current braking sys-

tem which is effective in producing a retarding torque, the utilization of copper presents a number of problems.

Perhaps the first and most important problem is that the copper warps during usage due to thermal expansion characteristics and due to its inherent ductility. The problem then becomes maintaining the spacing between the opposed pole pieces so as to provide a regulatable constant torque during the period of exercise. It will be appreciated that the provision of a constant torque for a constant setting dialed in by the user is important because during the period of exercise which may last as long as an hour or two, the physical characteristics of the braking system normally change due to thermal expansion of the mechanical parts. The result is neither proper calibration nor comfort for the user of the exercise device, due to constant adjustments which must be made in order to maintain constant torque.

Thermal considerations aside, variation in torque with speed of exercise is unacceptable. Prior problems in the variation of torque with speed are described in the following articles: C. Lanooy F. H. Bonjer, "A Hyperbolic Ergometer For Cycling & Cranking", J. Appl. Physiol. vol. 9, pp. 499–500, 1956, in which a copper disc was utilized in an eddy current braking system, and A. Krogh, "A Bicycle Ergometer and Respiration Apparatus For The Experimental Study of Muscular Work", Skand. Arch. Physiol. 33, pp. 375–394, 1913, in which work per revolution is said to vary with speed of the copper disc.

Thus, it is a design goal to achieve constant torque over a wide range of rotary speeds of the disc. Additionally, it is also important that the torque be constant throughout the period of exercise. Copper, while being an extremely good electrical conductor, has a problem that the torque delivered by the system employing the copper disc is neither relatively flat or constant for the range of exercise intended; nor is the torque provided by the eddy current/copper disc system controllable without elaborate feedback systems. Thus, for instance, the response of such a system to variations in pedal rotation of between 40 and 100 rpm is that, for a constant setting, the retarding torque is highly dependent upon the rotary speed of the pedals. The result for the end user is that there is an extremely annoying difference in the retarding force when pedaling at different speeds.

The variability of the retarding torque is more troublesome in medical applications when it is important that a constant torque be presented to the user of the exercise device in order to obtain proper measurement of exercise activity.

SUMMARY OF THE INVENTION

In order to solve the problems of the non-uniform torque and warping associated with copper discs, in the Subject Invention an aluminum disc is utilized. However, due to its decreased electrical conductivity vis-a-vis copper, the disc in one configuration is to be run at 320 to 800 rpm with an 8 to 1 ratio between the rotational speed of the disc and pedal speed. Also due to the lower electrical conductivity, a specialized 3 pole electromagnet is utilized at the periphery of the disc to multiply the magnetic flux by a factor of 3. This provides adequate braking while at the same time not inducing excessive amounts of heat.

It will also be noted that the opposed electromagnets are located on a line transverse to the plane of the disc. This allows thermal expansion of the disc without affecting the operation of the system. It will be appreciated that as the aluminum disc expands, it expands in a direction transverse to the line between the poles of the opposed electromagnets. In this embodiment the wheel is sandwiched between the two electromagnets. Thus the spacing between a pole and corresponding disc surface can be maintained constant.

The result of utilizing an appropriately spun up aluminum disc is that for a given current through the electromagnets, the retarding torque is constant between normal 40 and 100 rpm pedal speeds.

It will be appreciated that the subject aluminum disc has at least seven times the stiffness of copper, such that warpage is not a problem during thermal expansion. Nor is there any binding between the disc and the pole faces of the electromagnets. Also there is virtually no break away torque associated with such a system which leads to user comfort.

While it will be appreciated that the Subject Invention will be described in connection with bicycle-type exercise devices, the invention is not limited to the utilization of such an aluminum disc/eddy current braking system with an exercise bicycle. Rather, the Subject System may be utilized in any exercise device which causes rotary motion of a member coupled to the Subject eddy current braking system. As such rowing machines, stair climbing type apparatus or indeed any other type of apparatus which requires a braking torque are within the scope of the Subject Invention.

It has been found that an aluminum disc provides the unexpected result of an exceptionally flat torque response over the operating range of the system. Moreover, due to the structural stability of aluminum itself, as well as its light weight, warpage problems are eliminated. Additionally, calibration of the equipment is made relatively simple due to the constant torque applied for a constant current or voltage. Thus, problems in calculating the amount of work done or the amount of exercise of a given individual is made exceedingly simple due to this braking system which requires no feedback loops or circuits to maintain the constant retarding force.

In summary, an improved eddy current braking system for fly wheel braked exercise equipment includes the use of a flat aluminum disc and electromagnets to either side of the disc adjacent to the periphery thereof, with the electromagnets containing multiple pole pieces to multiply the torque so as to reduce heating and power consumption. For a constant setting, the utilization of aluminum achieves a flat torque versus speed characteristic vis-a-vis copper discs over the normal operating speed range. Additionally, the utilization of aluminum prevents the warpage associated with copper.

Even though copper has better electrical conductivity than aluminum which permits lower speed operation, it has been found that an aluminum fly wheel permits obtaining the same torque as with the prior art copper discs assuming geared spin up of the fly wheel. The utilization of aluminum has advantage over prior art ferrous metal eddy current brakes in that there is no residual magnetism which results in large break away torques to be provided. Nor when using aluminum is there a problem of displacement of the periphery of the disc in a lateral direction as is the case were one to position magnets to either side of a ferrous disc.

Moreover, because the magnetic pole pieces are placed to either side of the disc as opposed to inwardly directed along a radius at the periphery of the disc, clearance problems associated with the thermal expansion of the disc are eliminated in that the disc is allowed to radially expand with an increase in temperature without affecting the spacing between the disc and the pole pieces.

BRIEF DESCRIPTION OF DRAWINGS

These and other features of the Subject Invention will be better understood in connection with the Detailed Description taking in connection with the Drawings of which:

FIG. **1** is a side and diagrammatic view of the utilization of the Subject Invention in a recumbent bicycle exercise machine in which the pedals are utilized to drive an eddy current brake provided with an aluminum disc;

FIG. **2** is a diagrammatic and schematic diagram of the Subject System illustrating the utilization of an eddy current brake/aluminum disc system in which the aluminum disk is rotated about a shaft via a belt-driven pedal assembly;

FIG. **3** is a diagrammatic illustration of the specialized three pole yoke for the electromagnets used by the Subject System to provide enhanced eddy current braking for the aluminum disc;

FIG. **4** is a graph illustrating a prior art torque versus speed curve for prior art eddy current brakes indicating the hyperbolic nature of the curves;

FIG. **5** is a graph showing torque versus speed of an aluminum disc for a single reduction system having a ratio of 8:1 for a 14 inch diameter aluminum disc, with magnets on 12 inch diameters, illustrating that within the normal operating range the torque versus rpm curve is relatively flat for various current settings, thereby facilitating brake setting and measurement of the work done by the exercising individual; and,

FIG. **6** is a graph showing torque versus speed for a double reduction system in which there is a 21.8:1 ratio for a 10 inch diameter aluminum disc, with magnets on 8 inch diameters.

DETAILED DESCRIPTION

Referring now to FIG. **1**, a typical exercise machine **10** is illustrated, which may be a recumbent bicycle-type exercise machine in which an individual **12** is located on a seat **14** on frame **16** which houses a braking device for pedals **18** that revolve around a shaft **20**. The pedals are coupled to a wheel **22** mounted for rotation in the housing, with wheel **22** being braked as illustrated in FIG. **2** by a braking system **30** which includes an eddy current brake **32** including electromagnetically actuated coils **34** to either side of a flat aluminum disc **36** which is mounted for rotation about a shaft **37**. In the illustrated embodiment, a spin up 8:1 reduction system is illustrated in which there is an 8 to 1 difference in diameter between pulley **38** and wheel **22**. Note the linkage between the two is via a belt drive **40**. In the embodiment shown, the aluminum disc has a diameter **42** of 14 inches, whereas each electromagnet is maintained at a distance of 12 inches from shaft **37** as illustrated by arrow **45**.

The eddy current brake **32** is under control of a control unit **44** which is supplied with a.c. as illustrated at **46**. This control is settable from instrument cluster **48** in FIG. **1** so as to provide a constant braking torque to disc **36** and thus pedals **18** for constant current.

Because the disc is made out of aluminum, as will be demonstrated in FIGS. **5** and **6**, the torque applied to disc **36** is flat over the operating speed range of the disc. What this means is that for a pedaling speed range of 40 to 100 rpm, the corresponding speed of the disc is between 320 and 800 rpm. As will be demonstrated for almost all constant current settings, there is very little change in torque versus speed. Thus, unlike prior art systems in which there is either a linear or hyperbolic relationship between speed and torque, in the Subject System it has been found that the torque is relatively flat over the operating speeds of interest due to the use of aluminum for the disc.

This provides user **12** of FIG. **1** with an exceptional amount of consistency of applied torque regardless of the pedaling speed. This in turn makes adjustment of the braking force for exercise much easier and more predictable than in prior art eddy current devices. Moreover, measurement of the actual work done is more accurately predictable from the power consumed in the braking system so that critical medical measurements can be made for exercise devices utilizing the eddy current brake in combination with the rotating aluminum disc. Brake away torque is virtually non-existent in aluminum disc systems and, because the aluminum disc is non-magnetic, there is no residual magnetism for which compensation is necessary. Also it is a feature of the Subject Invention that any aluminum moving member may be utilized in the subject eddy current brake, regardless of shape.

Moreover, because the pole pieces of the opposed magnets which sandwich the aluminum disc are to either side of the disc, as opposed to being positioned at its periphery, and since thermal expansion occurs in the radial direction only, the spacing between the pole pieces and the disc surface is maintained relatively constant regardless of the amount of heating accompanying the exercise.

One of the features of the subject system is illustrated in FIG. **3** in which the electromagnets which sandwich disc **36** have a three pole E-shaped yoke configuration to magnify the eddy current effect by 3 times over a single pole piece yoke. In this embodiment three pole pieces **50**, **52**, and **54**, respectively north, south, and north, are opposed by opposite polarity pole pieces **56**, **58**, and **60**, with the E-shaped yoke oriented such that a line through the ends of the pole pieces is perpendicular to the radius of the disc for maximum braking torque. It will be noted that each of the electromagnets includes an energizing coil **62** and **64** respectively, each of which is energized through the supply of current from a controlled current supply **66** which has a.c. power **68** applied thereto and which is settable as illustrated. Disc **36** is rotated about a shaft which is mechanically coupled as illustrated at **70** to an exercise device **72**.

Because of the triple pole configuration of the yoke for each electromagnet, for a given amount of current, the eddy current effect is magnified by 3 times over that associated with a single pole electromagnet. The purpose of utilizing the triple pole configuration is in part to reduce the amount of power necessary to provide the predetermined braking force. However, a more important reason for the utilization of the triple pole magnet is to permit the utilization of the aluminum disc and the advantages which flow therefrom.

It can therefore be seen that the eddy current effect takes place over a larger portion of the aluminum disc than heretofor performed. The result in that the amount of torque is multiplied over the utilization of a single pole.

As illustrated in FIG. **4**, one type of prior art eddy current system, that shown in U.S. Pat. No. 3,442,131 issued to Jay Leyton of May 6, 1969, describes the extreme dependence of torque on speed. While in this patent it is said that it is preferable to operate the system at a linear portion of the curve, there is still an increase in torque of for an increase in pedal speed. Thus, rather than providing a constant torque for all usable pedal speeds, the Leyton device describes an increase in torque with pedal speed, albeit quasi-linear.

In contradistinction to this prior art torque versus speed characteristic, in the Subject System for a single reduction ratio of 8;1 the response of the torque is relatively flat for increased current settings. One plausible reason for the flatness of the torque versus speed characteristic is the lower electrical conductivity of the aluminum itself.

This same flat response is illustrated in FIG. **6** for a double reduction system in which the total reduction is 21.8:1, with a 10 inch diameter disc and magnets located on 8 inch diameters to either side of the disc. Note that the speeds of the discs are as indicated and correspond to a normal pedaling range of between 40 and 100 rpm.

While the subject invention has been described in connection with a rotary aluminum disc powered via bicycle type exercise apparatus, it will be appreciated that other types of exercise apparatus are within the scope of this invention, assuming that the exercise apparatus requires a constant torque braking system.

Having above indicated a preferred embodiment of the present invention, it will occur to those skilled in the art that modifications and alternatives can be practiced within the spirit of the invention. It is accordingly intended to define the scope of the invention only as indicated in the following claims:

I claim:

1. In an exercise cycle apparatus having pedals associated with an eddy current brake in which work performed by a pedaling individual is countered through the utilization of said eddy current brake in which a moving conductor in the form of a disc is passed adjacent magnets, the improvement of providing that said conductor be aluminum and providing that said eddy current brake has force multiplying heads, each of which including an electromagnet having a triple pole piece E-shaped yoke with three parallel legs pointing in the same direction and a coil surrounding the center pole piece and to which current is supplied, said eddy current brake including two of said yokes, one to each side of said disc so as to sandwich said disc therebetween, whereby the force multiplication associated with the E-shaped yoke permits the utilization of an aluminum disc to provide sufficient braking power for exercise apparatus.

2. The apparats of claim **1** wherein said exercise apparatus pedals have a normal operating range of 40–100 rpm.

3. The apparatus of claim **2** and further including means for multiplying the speed of rotation of said pedals by a predetermined ratio.

4. The apparatus of claim **3** wherein said ratio is 8:1.

5. The apparatus of claim **3** wherein said ratio is 21.8:1.

* * * * *

United States Patent [19]
Tsuyama
[11] Patent Number: 4,775,145
[45] Date of Patent: Oct. 4, 1988

[54] LOAD APPLYING MEANS FOR AN EXERCISE DEVICE

[75] Inventor: Sadaharu Tsuyama, Osaka, Japan
[73] Assignee: Tsuyama Mfg. Company, Ltd., Japan

[21] Appl. No.: 773,349
[22] Filed: Sep. 6, 1985

[30] Foreign Application Priority Data
Feb. 2, 1985 [JP] Japan 60-28780

[51] Int. Cl.4 .... A63B 21/24; A63B 21/00
[52] U.S. Cl. 272/73; 272/129; 272/DIG. 6
[58] Field of Search .... 272/73, DIG. 5, 129, 272/DIG. 6; 310/93, 94, 268, 105, 95, 178

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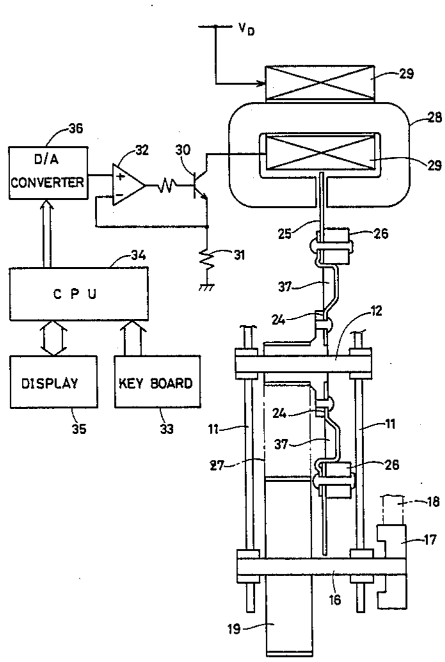
Primary Examiner—Richard J. Apley
Assistant Examiner—S. R. Crow
Attorney, Agent, or Firm—Allegretti & Witcoff, Ltd.

[57] ABSTRACT

A load applying device for an exercise device for applying a load to a shaft rotating at a speed higher than a predetermined speed comprising a frame rotatably supporting the shaft, means operated by the user for rotating said shaft, and rotated therewith and an electromagnet disposed adjacent the rotating disc and cooperating therewith so that magnetic flux traversing the surfaces of the rotating disc is generated to apply brake torque to the rotating disc. Preferably, the electromagnet comprises a main body with a core and an exciting body wound on the core, and control means for controlling the current applied to the exciting coil. The load applying device includes speed increasing mechanism which may comprise a first stage motion transmitting chain and gear mechanism and a second stage belt and rotating body mechanism.

14 Claims, 4 Drawing Sheets



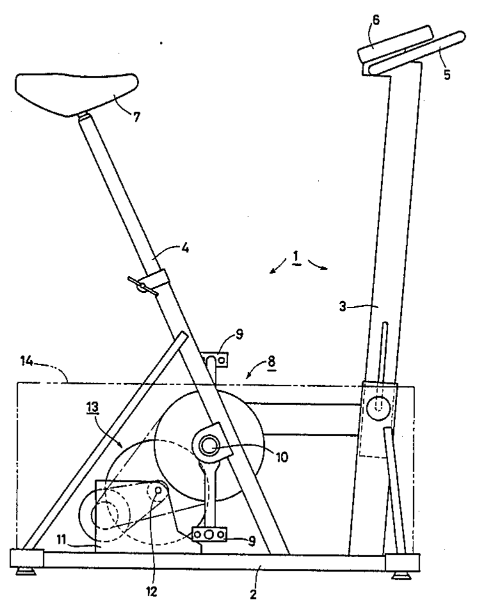
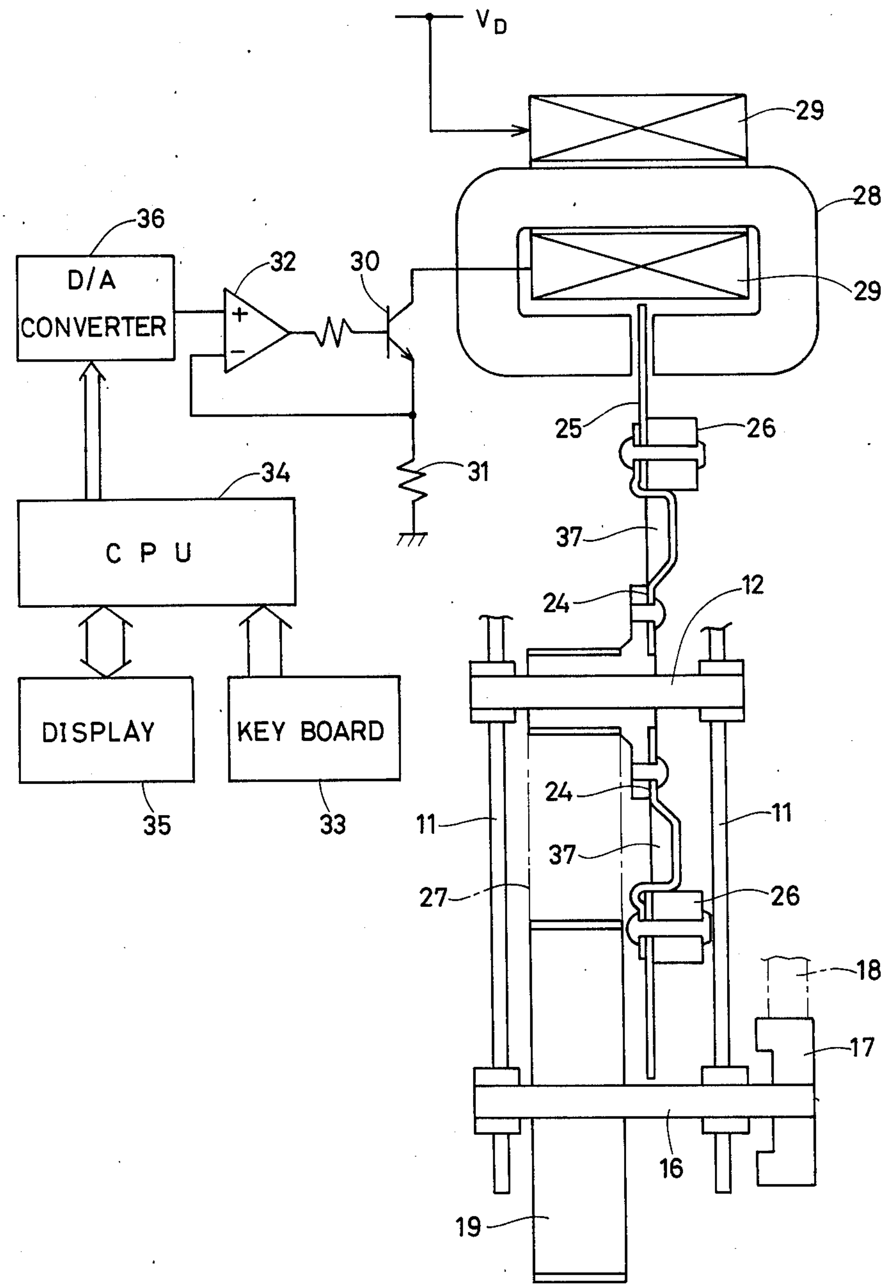


FIG. 1



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29
36
D/A CONVERTER
32
30
+
−
25
26
34
31
CPU
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24
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DISPLAY
KEY BOARD
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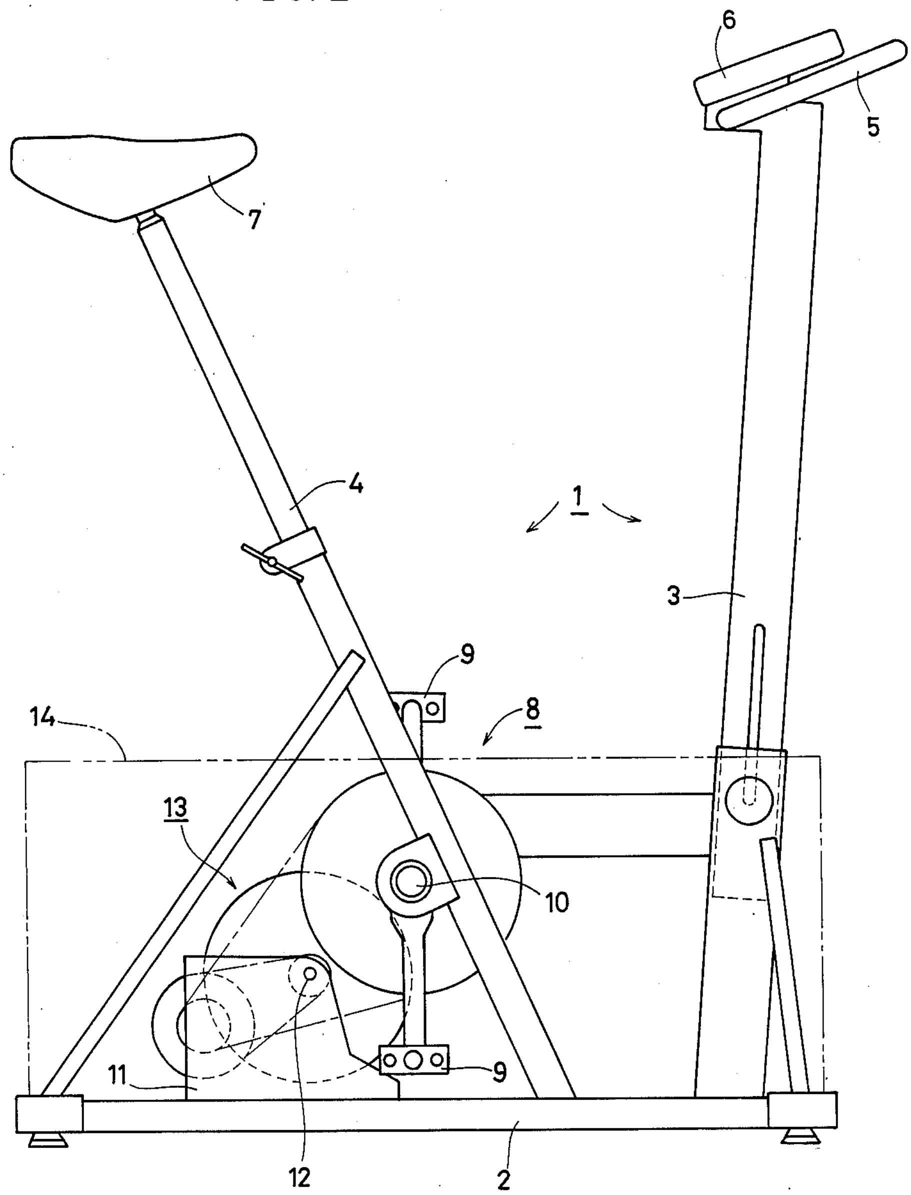
FIG. 2



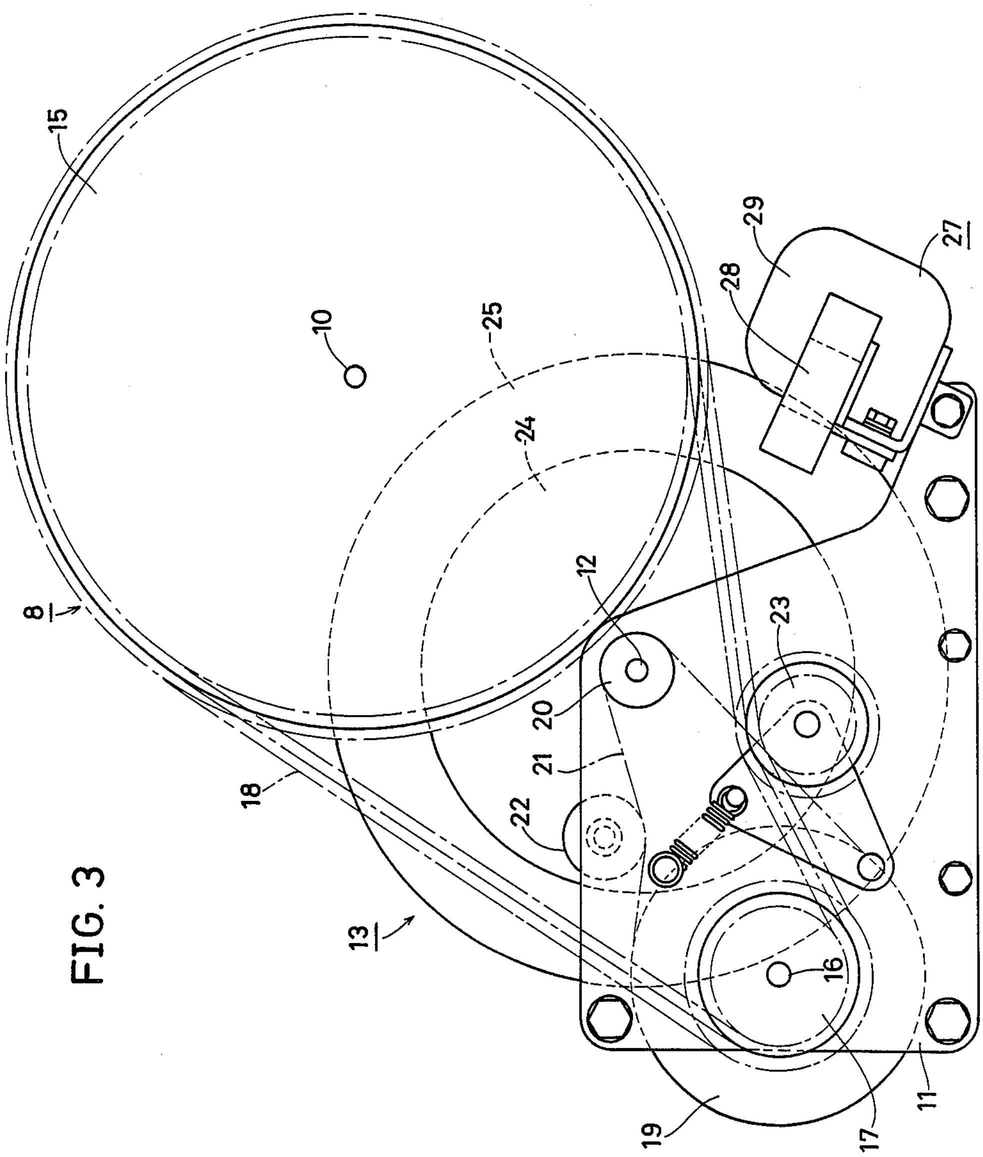


FIG. 3

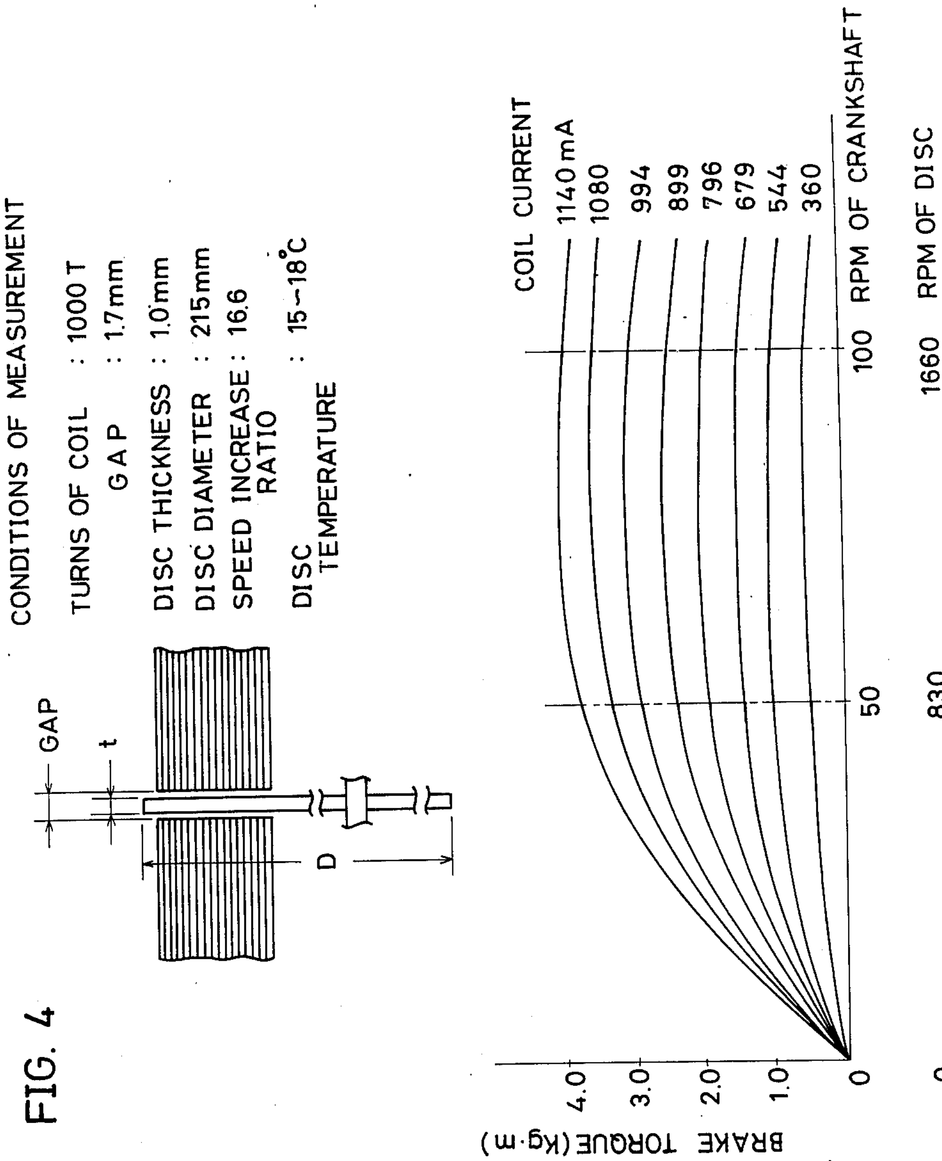

CONDITIONS OF MEASUREMENT
TURNS OF COIL : 1000 T
GAP : 1.7mm
DISC THICKNESS : 1.0mm
DISC DIAMETER : 215mm
SPEED INCREASE RATIO : 16.6
DISC TEMPERATURE : 15~18°C
GAP
t
D
COIL CURRENT
1140 mA
1080
994
899
796
679
544
360
BRAKE TORQUE (Kg·m)
4.0
3.0
2.0
1.0
0
0
50
100
RPM OF CRANKSHAFT
0
830
1660
RPM OF DISC

FIG. 4

LOAD APPLYING MEANS FOR AN EXERCISE DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to a device for applying load to a rotating shaft. Particularly, the present invention relates to an improvement of a device for applying load to a rotating shaft not mechanically but magnetically.

A device of this invention can be used for example as a load applying device for various motors or as a load applying device for an ergometer and the like.

It is necessary for a load applying device to apply continually an arbitrary load (brake torque) to a rotating shaft of an apparatus which receives the load. Therefore an excellent durability is required for such a load applying device.

Such a load applying device in the prior art will be described in the following, by taking an example of a load applying device used in an ergometer.

The Japanese patent Publication Gazette No. 8267/1983 discloses an example of the prior art concerning a total structure of a training apparatus of the pedal type including a load applying device (a training apparatus of this type being referred to in this specification as an "ergometer"). As described in the above stated gazette, the load applying device of an ergometer is generally of the system in which the magnetic field of an exciting coil generates eddy current in an object such as an eddy current plate to which brake torque is to be applied (this system being referred to hereinafter as the "eddy current system"). This system is advantageous in that little friction is caused in the apparatus and control can be made relatively easily, as compared with a system in which brake torque is applied by mechanical friction force.

The Japanese Utility Model Laying-Open Gazette No. 166058/1981 discloses a brake device (a load applying device) of an ergometer where an exciting coil is provided on one of the side surfaces of a rotating disc to which brake torque is applied.

The Japanese Utility Model Publication Gazette No. 8509/1972 shows an example of a heat radiation structure in a load applying device of the eddy current system.

One of the important conditions required for a load applying device is that load to be applied to an object, namely, brake torque can be set to an arbitrary fixed value, irrespective of the rotation speed of the object.

One reason for this is that in the case of an ergometer, for example, calculation of the kinetic amount of a person exercising using the ergometer cannot be made correctly, as desired, if the brake torque of a load applying device changes dependent on the rotation speed of the pedals, thus making the ergometer perform its function unsatisfactorily.

Another reason is that the brake torque applied by a load applying device can be generally utilized for many purposes if it can be set freely to an arbitrary fixed value independently of the rotation speed of an object to which the torque is applied.

None of the above stated conventional load applying devices of the eddy current system satisfy the aforesaid condition, all of them involving a disadvantage that if the speed of stepping on the pedals, namely, the rotation speed of the crankshaft changes, the applied brake torque also changes irregularly.

In addition, the devices of the later two gazettes mentioned above involve another disadvantage that a structure for forming a magnetic path becomes complicated.

The present invention pertains to a device for applying load to a load shaft rotating at a speed higher than a prescribed rotating speed, comprising:

a rotating disc coupled to said load shaft so as to be rotated, and

an electromagnet disposed in a position where main surfaces of said rotating disc are inserted in said eletromagnet but are not in contact therewith, so that magnetic flux traversing the surfaces of said rotating disc is generated to apply brake torque to said rotating disc.

If the present invention is applied in an ergometer as a preferred embodiment, the invention further comprises:

a crankshaft having pedals, and

a speed increasing mechanism provided in association with said crankshaft and said load shaft for increasing the rotation speed of the crankshaft to transmit the increased rotation speed to the load shaft, a speed increase ratio at the time of transmission being selected so that the rotation speed of the load shaft may be higher than the above stated prescribed rotation speed with the rotation speed of the crankshaft being in the range of practically applicable speed.

Since a closed magnetic path is formed by the rotating disc and the electromagnet facing both sides of the rotating disc, eddy current is generated efficiently in the rotating disc.

Further, since the rotation speed of the load shaft is set to a value higher than a prescribed rotation speed, brake torque applied to the rotating disc by the eddy current generated in the disc functions in a saturated region. Therefore, stable brake torque is applied irrespective of the rotation speed of the load shaft.

In the case of a preferred embodiment of the invention adopted in an ergometer, the rotation speed of the load shaft is maintained at a value higher than the above stated prescribed speed by the speed increasing mechanism and accordingly, brake torque is stably applied.

BRIEF DESCRIPTION OF THE DRAWINGS

There is shown in the attached drawing a presently preferred embodiment of the invention wherein like numerals in the various views refer to like elements and wherein:

FIG. **1** is a structural view showing an essential part of an embodiment of the present invention;

FIG. **2** is a side view showing a total structure of an ergometer in which an embodiment of the present invention is adopted;

FIG. **3** is a detailed view of a load applying device in FIG. **2**; and

FIG. **4** is a graph showing eddy current load characteristics of an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

In the following, a concrete embodiment of the present invention will be described in detail with reference to the drawings, taking an example of a load applying device used in an ergometer.

FIG. **2** is a side view showing a total structure of an ergometer emboodying of the presesnt invention. A frame 1 made of a construction material such as steel tubing or frame material, comprises at least a base 2 and a front and a back stays 3 and 4, both having variable height. An upper end of the front stay 3 comprises a handle 5 having a loop shape as a plane figure for example and a control panel 6. The control panel 6 is provided with a keyboard for regulating brake torque and the like to be applied to the load shaft, a display for displaying the running distance and other components, as described later. An upper end of the back stay 4 comprises a saddle 7. On the base 2, a load applying device 8 is provided.

The load applying device 8 comprises a crankshaft 10 attached to the back stay 4 having pedals 9 and a load shaft 12 supported by a support frame 11 on the base 2. The crankshaft 10 and load shaft 12 are coupled by a speed increasing mechanism 13 having two speed increase stages. The construction of the load applying device 8 excluding the pedals is usually protected by a cover 14 shown by the chained line for the purpose of preventing clothes etc. of a user from being caught in the device or for the purpose of protection from dust.

FIG. 1 and 3 are views showing an essential part of the load applying device 8. First referring to FIG. 3, the speed increasing mechanism 13 comprises: a first speed increase stage including a crank wheel 15 of a large diameter fixed to the crankshaft 10, a wheel 17 of a small diameter fixed to an intermediate shaft 16 rotatably held by the support frame 11 and a chain 18 set on the two wheels; and a second speed increase stage including a pulley 19 of a large diameter fixed to the intermediate shaft 16, a pulley 20 of a small diameter fixed to the load shaft 12 and a timing belt 21 set on the two pulleys. Thus, the speed increasing mechanism is so structured that a speed increase ratio of the mechanism 13, namely a speed increase ratio between the crankshaft 10 and the load shaft 12 can be set to a large value. In FIG. 3, the reference numeral 22 indicates a tension pulley for tightening the timing belt 21 and the reference numeral 23 indicates a derailleur for tightening the chain 18. In this embodiment, the speed increase ratio is set to 16.6/1.

Although in this embodiment, the speed increasing mechanism 13 is structured by the wheels and the chain set therebetween, as well as by the pulleys and the timing belt set therebetween, it may be structured by a combination of only the wheels and the chains or only the pulleys and the timing belts. In addition, the speed increasing mechanism 13 may be structured by a combination of gears.

Further, the speed increasing mechanism 13 may be structured with any number of speed increase stages, say, a single stage or three or more stages, the number being not limited to two as mentioned above, insofar as the rotation speed of the crankshaft 10 is increased and transmitted to the load shaft 12 and the rotation speed of the load shaft 12 can be made higher than a prescribed rotation speed (an example of a concrete value thereof being mentioned later) with the rotation speed of the crankshaft 10 being in the range of a practically applicable speed (an example of a concrete value thereof being mentioned later).

Now referring to FIGS. 1 and 3, around a wheel 24 fixed to the load shaft 12, a circular disk 25 made of a copper plate for example is fixed so that the disk 25 and the wheel 24 form one body to have an increased diameter. In addition, in order to make smooth the rotation of the disk 25 and the rotation of the wheel 24, a circular weight ring 26 functioning as a fly wheel is attached for example in a portion of coupling between the wheel 24 and the disk 25. As a result, the disk 25 and the load shaft 12 can rotate smoothly and the structure can be made simpler than in the case of providing a fly wheel for that purpose.

In association with the disk 25, a single electromagnet 27 is provided in a manner fixed to the support frame 11. The electromagnet 27 comprises a core 28 and an exciting coil 29 wound onto the core 28 on a coil bobbin (not shown). The core 28 in this embodiment has the form of the letter C opened at one point so that the two main surfaces of the disc 25 are interposed in the opening between the end surfaces of the core, but are not in touch or contact with the end surfaces.

Core 28 is preferably a cut core having a single cut on multiple turns of a band steel. This is because a cut core, even if of a small size, has a high density of magnetic flux and is capable of generating a larger quantity of eddy current in the disc 25 as compared with a ordinary multi-layer core and accordingly the brake torque applied to the disc 25 can be substantially increased.

Although in this embodiment, only one electromagnet 27 is used, it goes without saying that a structure having two or more electromagnets may be adopted in cases where more intense brake torque is required.

The structure of the electromagnet 27 is not limited to that in this embodiment. For example, the following structure may be adopted. A set of two electromagnets each comprising a column-like core and an exciting coil wound on the core may be used so that the electromagnets may be disposed on both sides of the disc 25. In sum, as both surfaces of the disc 25 are placed in an intermediate space provided in one or more electromagnets in the state where the surfaces of the disc 25 are not in contact with the electromagnets, any form or any structure may be adopted for the electromagnets.

One end of the exciting coil 29 is connected to a DC power source V_D and the other end thereof is grounded through a control transistor 30 and a resistor 31. To the base of the control transistor 30, an output of a comparator 32 is supplied. Control transistor 30, control resistor 31 and comparator 32 form a current control circuit, whereby the set current is made to flow in the exciting coil 29.

Setting of the current flowing in the exciting coil 29 is made in the below described manner by means of a keyboard 33, a central processing unit (CPU) 34, a display 35 and a digital to analog (D/A) converter 36 provided in the control panel 6 (see FIG. 2). The user enters desired brake torque (namely, load of the ergometer according to his own physical strength) by means of the keyboard 33. The entered brake torque is displayed on the display 35 through the CPU 34 to be ascertained by the user. When the brake torque is determined, the CPU 34 calculates exciting current necessary for applying the brake torque. This calculation of the exciting current value is performed based on the relation:

$$\text{brake torque} = k_2 + f(I)$$

where k_2 is a prescribed load value independent of current and f(I) is a load value changing dependent on current. Then, the CPU 34 applies a control signal to the comparator 32 through the D/A converter 36 so that the calculated current may flow in the exciting coil 28.

Preferably, the CPU 34 has a further function of calculating the kinetic amount of the user so that the kinetic amount is represented on the display 35.

An example of the eddy current load characteristics in a relation between the disc 25 and the exciting coil 28 is shown in FIG. 4. The characteristic curve in FIG. 4 is obtained as a result of measurement under the conditions set as follows:

Number of turns of the exciting oil: 1000 t

Opening or gap between the opposed end surfaces of the C shaped core: 1.7 mm

Thickness t of the disc: 1.0 mm

Diameter D of the disc: 215 mm

Speed increase ratio: 16.6/1

Surface temperature of the disc at the time of measurement: 15° to 18° C.

In this embodiment, the number of revolutions per minute of the crankshaft 10 is in the range of 50 to 100 as a practically applicable range in the ergometer and the speed increase ratio of the speed increasing mechanism 13 is set to 16.6 as previously described so that the number of revolutions per minutes of the load shaft 12, namely, that of the disc 25 may be in the range of 830 to 1660 with the number or revolutions per minute of the crankshaft rotation being in the above stated range. Thus, by setting the speed of the load shaft 12 to a value higher than the prescribed rotation speed, the brake torque applied to the disc 25 can be made almost stable as is clear from FIG. 4. This is because, with the revolution speed of the disc 25 higher than a prescribed value, generated eddy current can be utilized in a saturated region and influence by the rotation speed of the disc 25 as in the non-saturated region (in the region of the rotation speed of the disc lower than 830 rpm in FIG. 4) can be avoided.

Accordingly, in this embodiment, brake torque can be set to an arbitrary fixed value by making regulation finely or without grades in the range of the rotation speed of the disc 25 of 830 to 1660 rpm, in other words, in the range for practically using the pedals. Thus, the kinetic amount of the user can easily be calculated.

Further, in this embodiment, a plurality of sheets of fins 37 are formed in positions on the main surface of the disc 25, not interfering with the electromagnet 27, namely, on the main surface of the disc near the circumference of the wheel 24. The fins 37 may be formed radially in circles on the main surface of the disc 25 each in a curved shape (a concave shape as viewed from one side and a convex shape as viewed from the other side), or as rectangular projections diametrically provided on the main surface of the disc 25, each being cut and raised from the disc 25, except one side.

These fins 37 serve for ventilation of the disc 25 or for radiation of Joule heat caused by the eddy current transmitted from the disc 25 so that the temperature on the surfaces of the disc 25 may be maintained in the vicinity of the normal temperature (15° to 18° C. in the embodiment) to prevent the brake torque from being lowered by increase of the temperature.

As described in the foregoing, the present invention makes it possible to generate eddy current efficiently in the rotating disc and to obtain intense brake torque with a small-sized eletromagnet, since the electromagnet is disposed in a manner where the main surfaces of the rotating disc are inserted therein.

Further, in a preferred structure only one electromagnet, and therefore only one coil as the exciting coil are needed and accordingly, brake torque can be easily regulated by the current control.

If the present invention is applied in an ergometer, brake torque can be maintained constant with the rotation speed of the crankshaft by the pedals being in a practically applicable range in the speed increasing mechanism and as a result, the same load as if in the case of riding on a bicycle on the flat ground can be applied to the user and he will have a comfortable feeling at the time of using such an ergometer.

Further, the kinetic amount (work amount) of the user, which is represented by the product of the revolutions per minute of the crankshaft and the brake torque, can be calculated easily since the brake torque is constant.

In addition, since the brake torque can be set to an arbitrary fixed value, the present invention makes it possible to provide a device by which the user can exercise according to his physical strength.

While I have shown and described a presently preferred embodiment of the present invention, it will be understood that modifications can be made therein without departing from the spirit of the invention.

What is claimed:

1. An exercise device comprising a load applying means for applying load to a load shaft in said exercise device, which load shaft is adapted to rotate at a speed higher than a prescribed rotation speed, comprising:

a frame for rotatably supporting said load shaft, including means for supporting a user.

means operated by the user for rotating said load shaft.

a rotating disc coupled to said load shaft so as to be rotated therewith, and

an electromagnet disposed adjacent said rotating disc in a position where main surfaces of said rotating disc are inserted in said electromagnet, but are not in contact therewith, so that magnetic flux transversing the surfaces of said rotating disc is generated to apply brake torque to said rotating disc, whereby generated eddy current is utilized in a saturated region and stable brake torque is applied irrespective of the rotating speed of the load shaft, said electromagnet comprising a core and an exciting coil wound on said core and control means for controlling the current applied to said coil, wherein said control means comprises torque setting means and calculating means for calculating the necessary quantity of current to apply as control torque the torque set by said setting means whereby the quantity of current applied to said coil is regulated by said control means to change the brake torque applied to said disc.

2. A load applying means as set forth in claim 1, wherein said core being in the form of the letter C and being disposed in a manner where said main surfaces of said rotating disc are interposed in an opening formed between opposed end surfaces of said core.

3. A load applying means as set forth in claim 1, wherein a cut core is used as said core of said electromagnet.

4. A load applying means as set forth in claim 1, wherein said rotating disc is provided with fins for radiation of heat.

5. A load applying means as set forth in claim 1, wherein, said means operated by said user includes a crankshaft having pedals, and a speed increasing mechanism provided in association with said crankshaft and

said load shaft for increasing the rotating speed of said crankshaft to transmit said increasing rotating speed to said load shaft, a speed increase ratio at the time of transmission being selected so that the rotation speed of said load shaft may be higher than said prescribed rotation speed with the rotation speed of said crankshaft being in the range of a practically applicable speed.

6. A load applying means as set forth in claim **5**, wherein said core being in the form of the letter C and being provided in a manner where said main surfaces of said rotating disc are interposed in an opening formed between opposed end surfaces of said core.

7. A load applying means as set forth in claim **6**, wherein a cut core is used as the core of said electromagnet.

8. A load applying means as set forth in claim **7**, wherein said rotating disc is provided with a weight ring so that said rotating disc rotates with inertia.

9. A load applying means as set forth in claim **5**, wherein said speed increasing mechanism is so constructed that increase of speed is made at a plurality of stages.

10. A load applying means as set forth in claim **9**, wherein a motion transmitting mechanism comprising a chain and a gear is included in said speed increasing mechanism.

11. A load applying means as set forth in claim **9**, wherein a motion transmitting mechanism comprising a belt and a rotating body is included in said speed increasing mechanism.

12. A load applying means as set forth in claim **9**, wherein a combination of a first stage motion transmitting mechanism comprising a chain and a gear and a second stage motion transmitting mechanism comprising a belt and a rotating body are adopted in said speed increashing mechanism.

13. A load applying means as set forth in claim **1**, wherein said calculation being based on the relation:

$$\text{torque} = k_2 + f(I)$$

where K_2 is a prescribed load value independent of current and f(I) is a load value changing depend on current.

14. A load applying means as set forth in claim **5**, wherein said rotating disc is provided with fins for radiation of heat

* * * * *

US 20100144496A1
APPENDIX MM

(19) **United States**
(12) **Patent Application Publication**
Schmidt

(10) **Pub. No.: US 2010/0144496 A1**
(43) **Pub. Date: Jun. 10, 2010**

(54) **SPEED CONTROLLED STRENGTH MACHINE**

(76) Inventor: **David H. Schmidt**, Darien, CT (US)

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(21) Appl. No.: **12/648,531**

(22) Filed: **Dec. 29, 2009**

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/420,928, filed on Apr. 9, 2009, now Pat. No. 7,641,597, which is a continuation of application No. 10/685,625, filed on Oct. 15, 2003, now Pat. No. 7,179,205, which is a continuation-in-part of application No. 09/977,123, filed on Oct. 12, 2001, now Pat. No. 6,835,167, which is a continuation of application No. 08/865,235, filed on May 29, 1997, now Pat. No. 6,302,829.

(60) Provisional application No. 60/418,461, filed on Oct. 15, 2002, provisional application No. 60/018,755, filed on May 31, 1996.

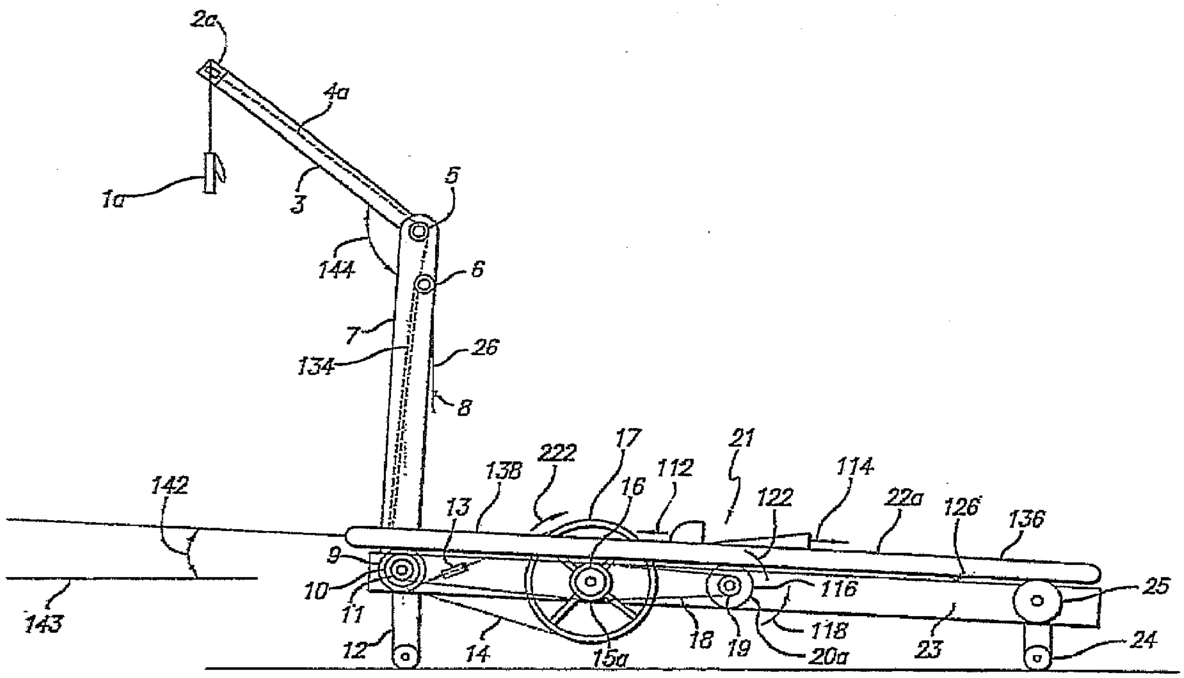
Publication Classification

(51) **Int. Cl.**
A63B 22/04 (2006.01)

(52) **U.S. Cl.** **482/70**

(57) **ABSTRACT**

A speed controlled strength machine is provided. The machine includes a frame and a number of support members. A driver is mounted to the frame and includes an adjustable speed controller. During exercise, the user engages grips/handles and pulls them via one-way clutches through the resistive movement of the driver. The clutches are engaged when the user is able to reach a predetermined speed, which is adjustable and controllable.



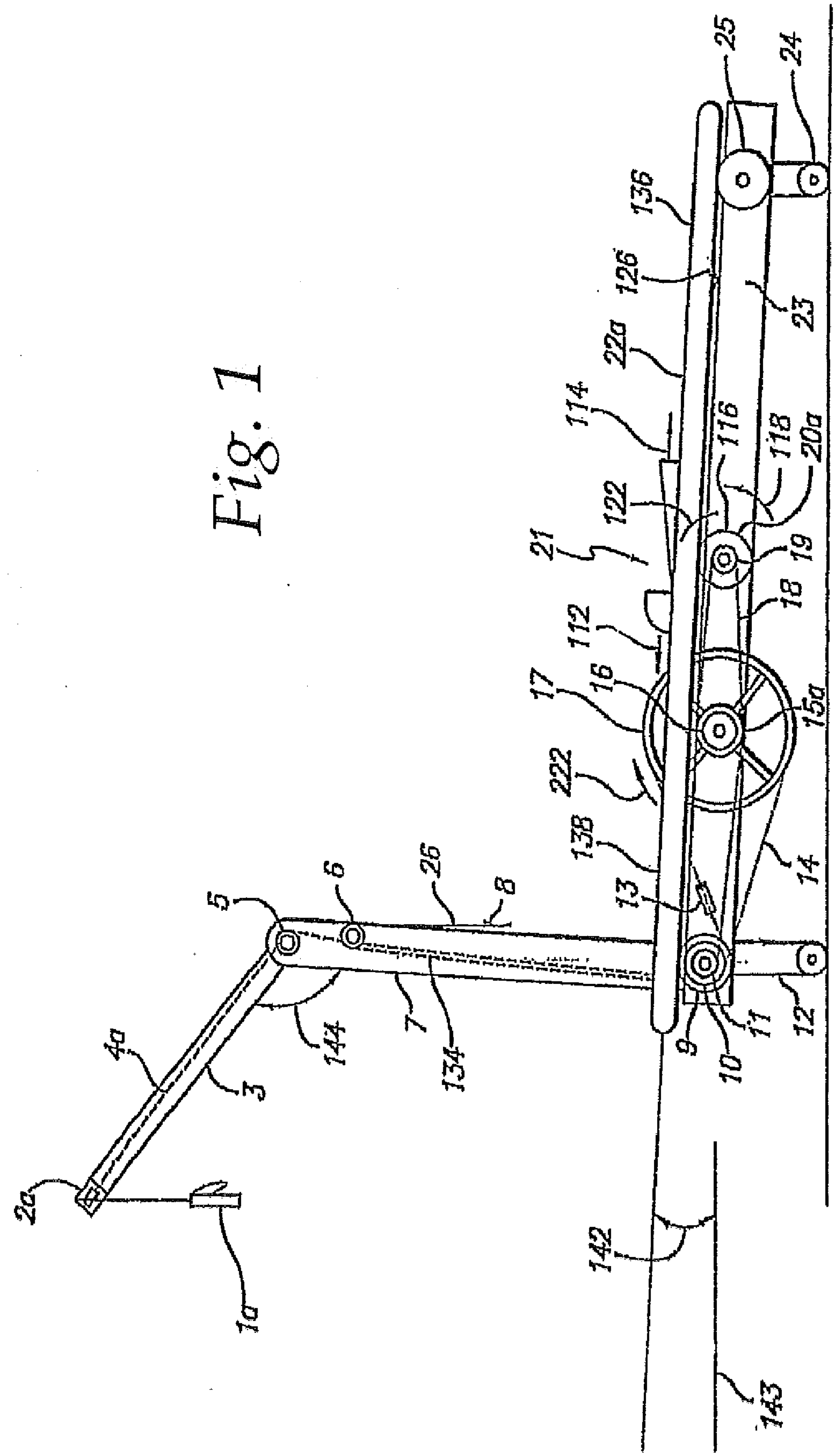


Fig. 1

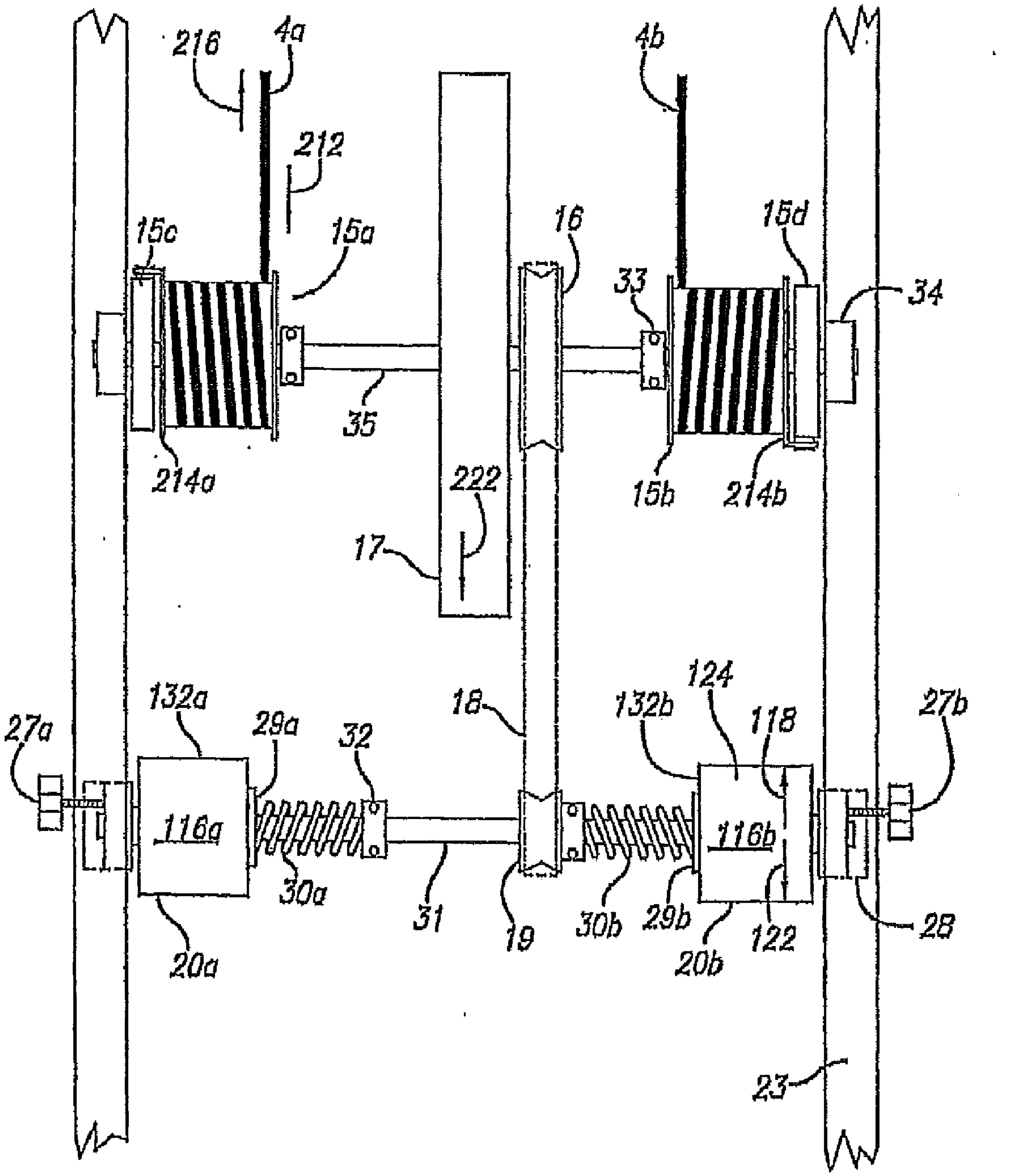

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Fig. 2

Fig. 3

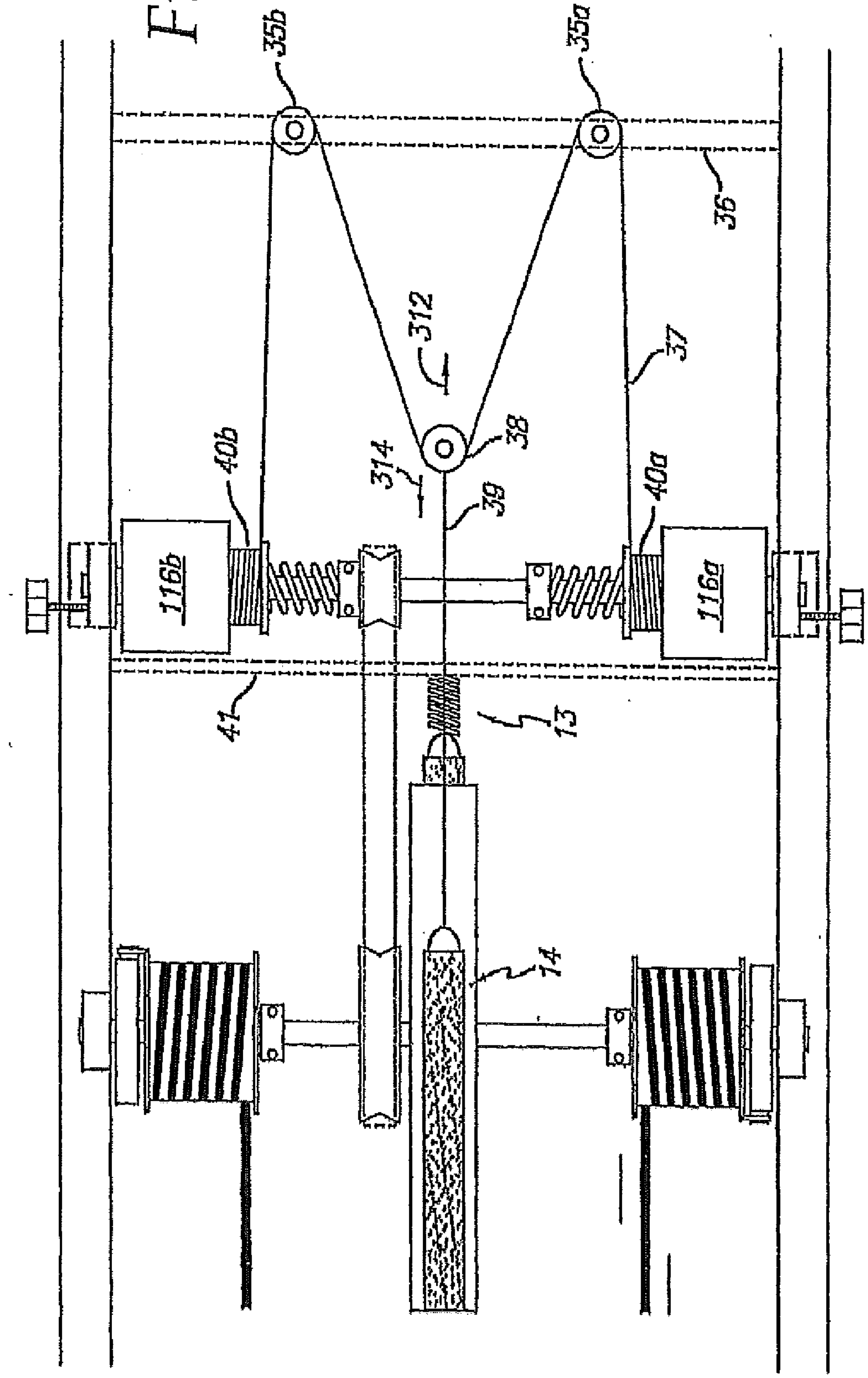
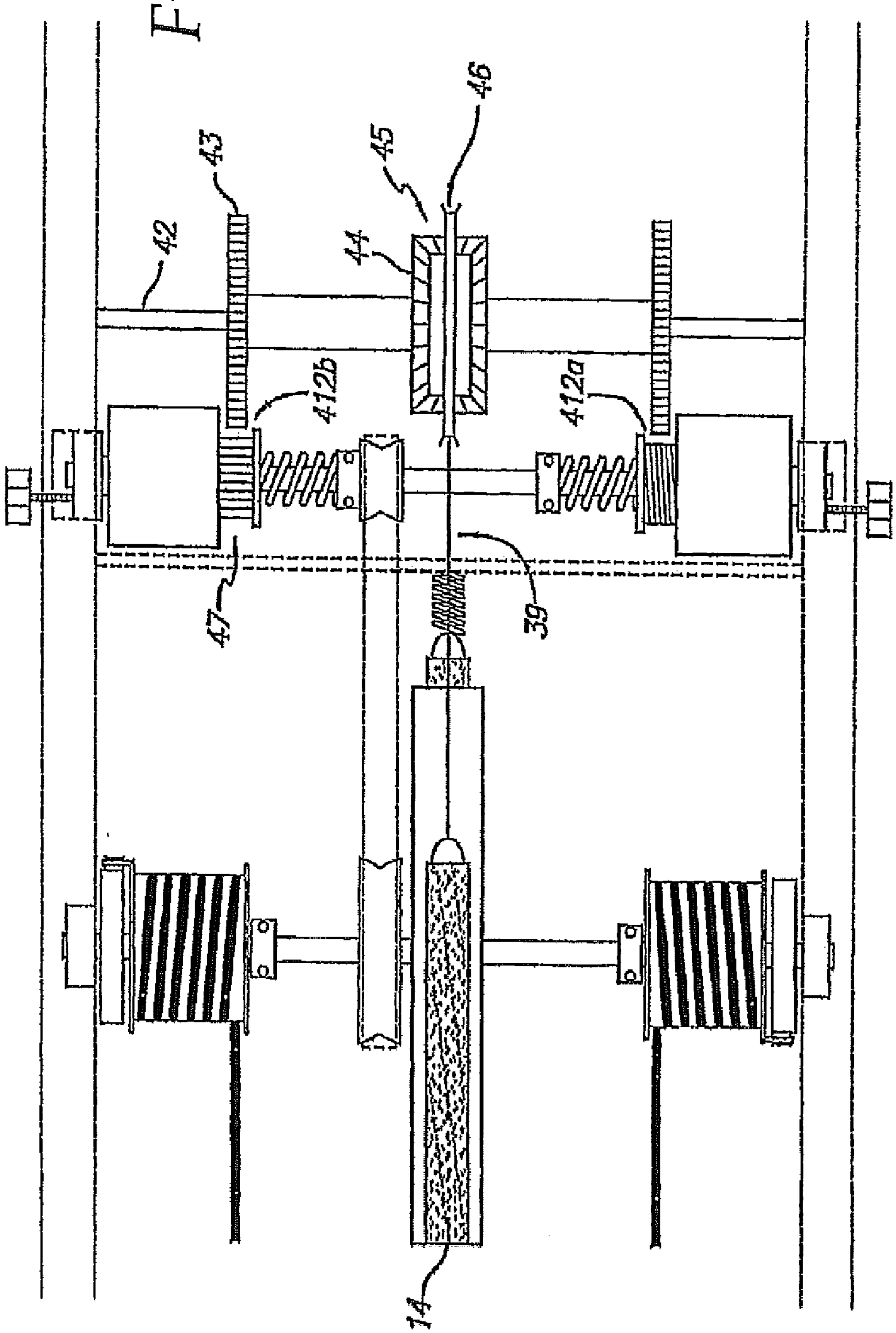
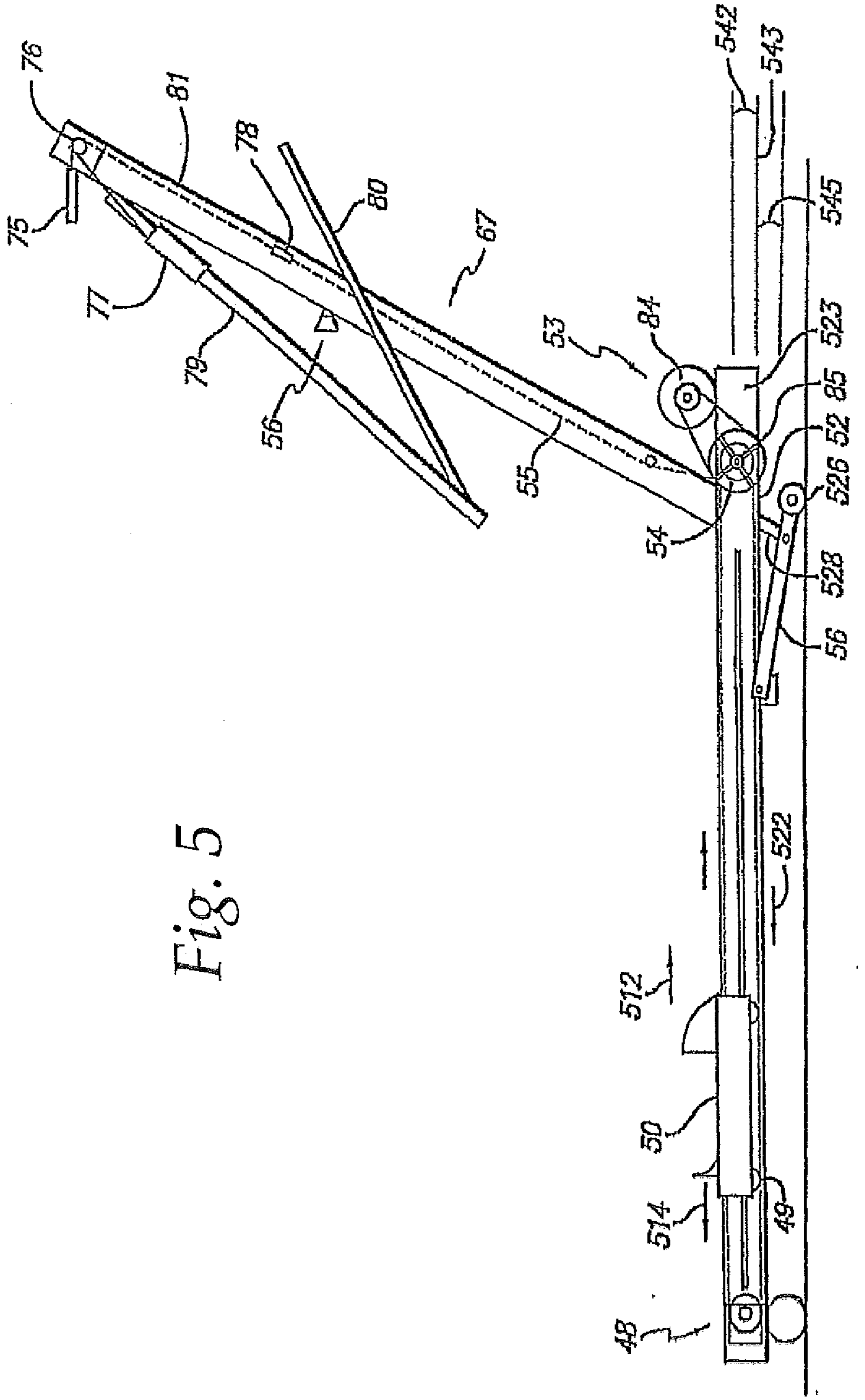


Fig. 4

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54
542
543
545
523
85
52
526
528
56
522
512
50
514
49
48

Fig. 5

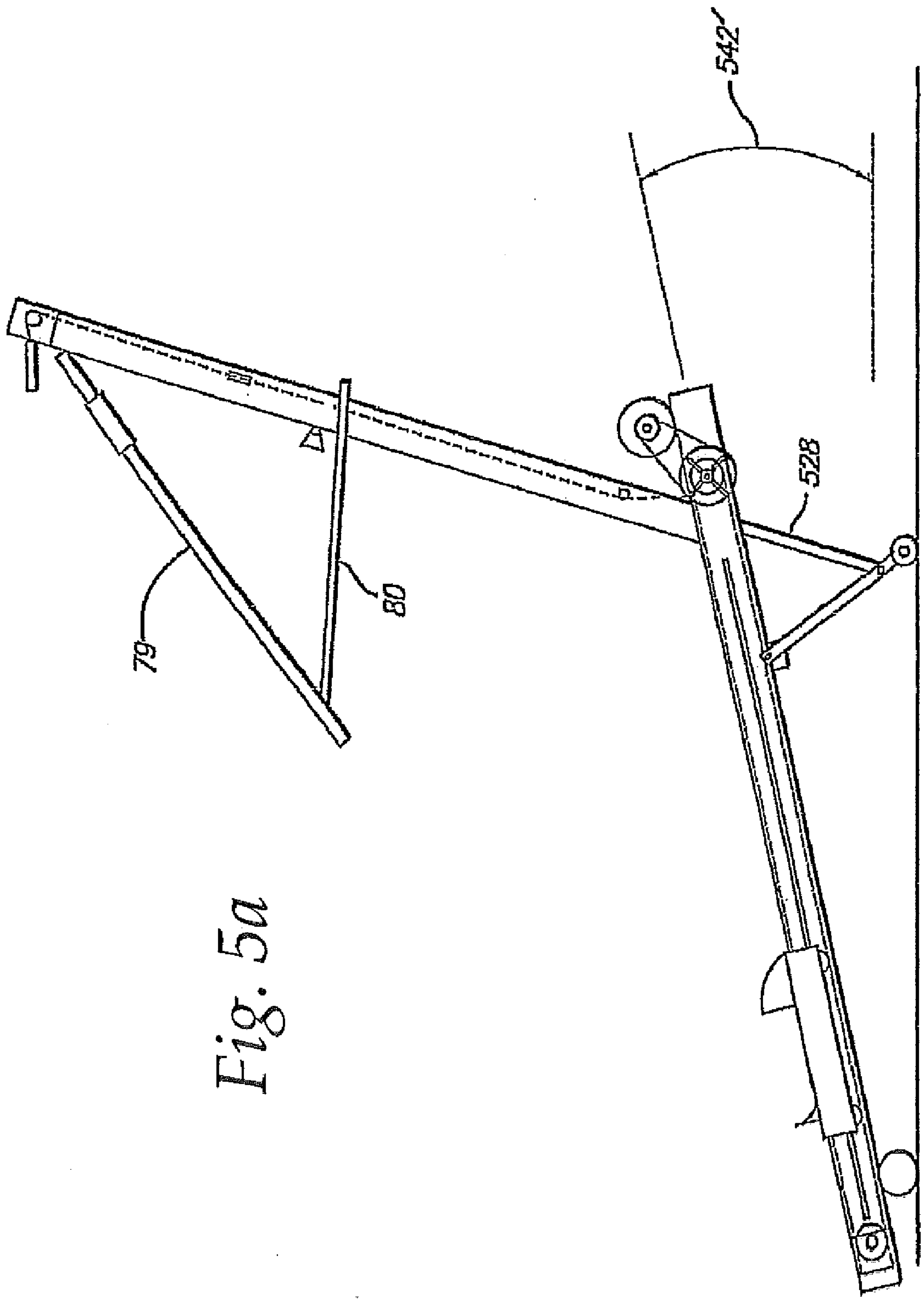


Fig. 5a

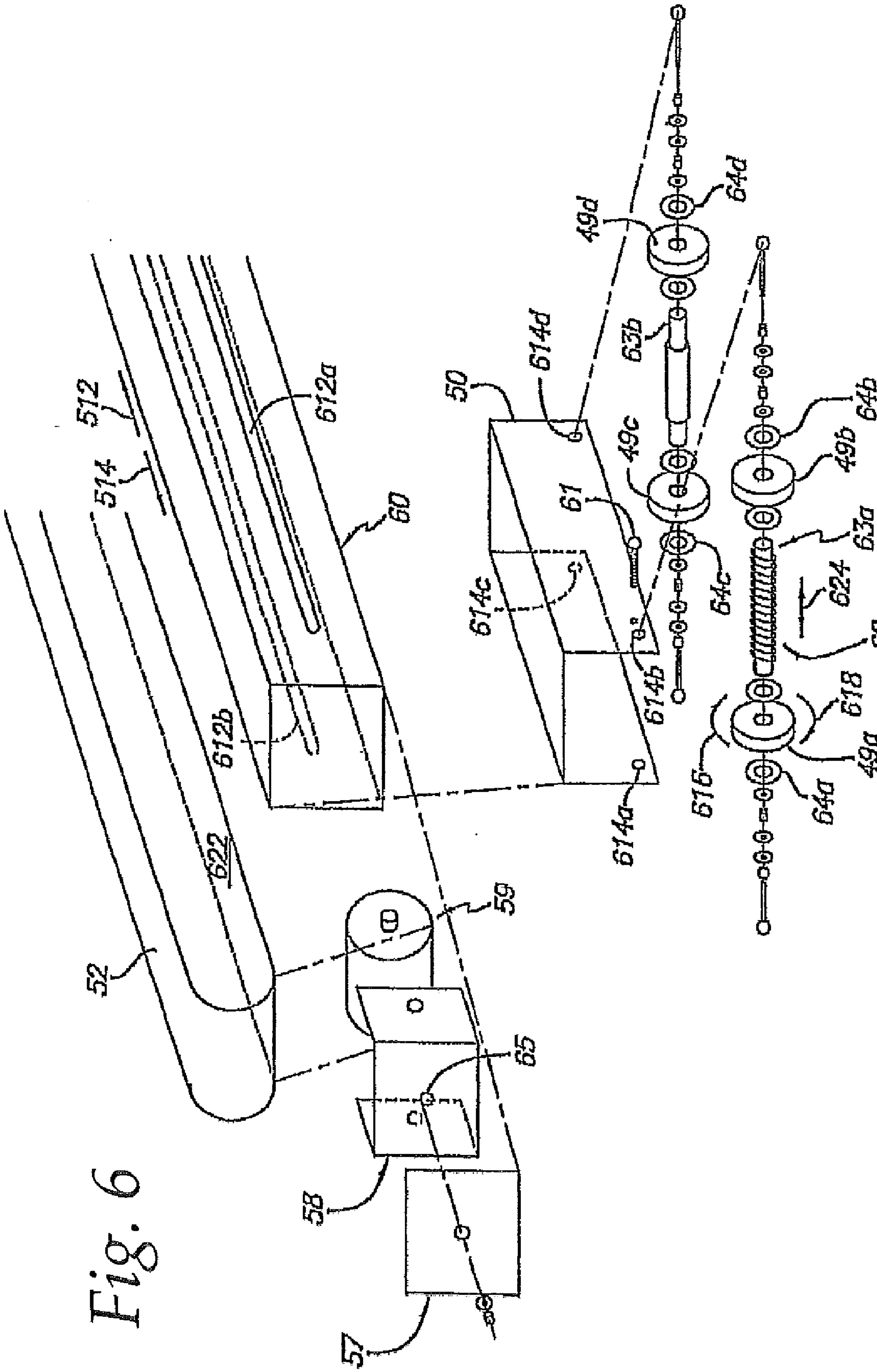

512
514
612a
60
50
614d
49d
64d
63b
49c
61
64c
614c
614b
49b
64b
63a
624
62
618
616
49a
64a
614a
612b
622
52
59
65
58
57

Fig. 6

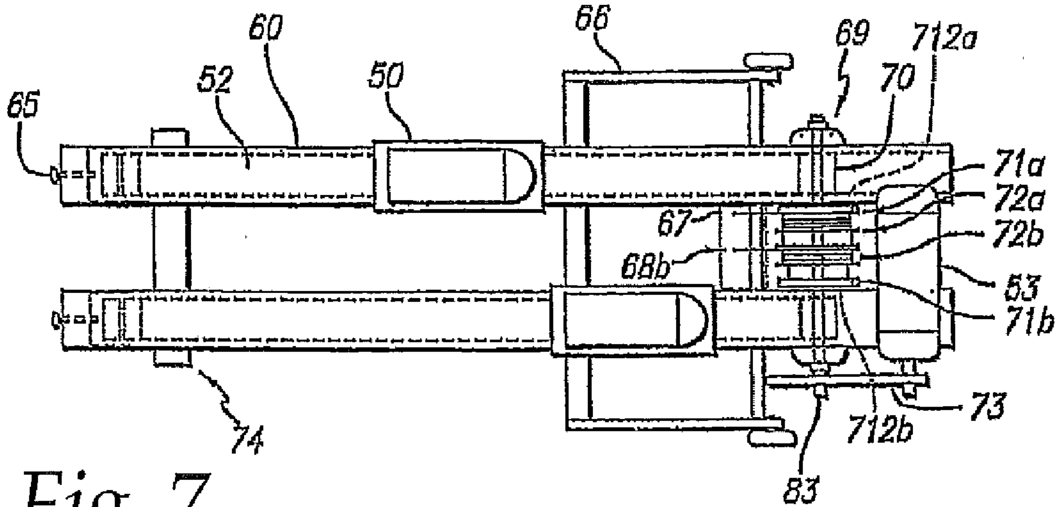

60
66
69
712a
52
50
70
65
71a
72a
67
72b
68b
53
71b
73
74
712b
83

Fig. 7

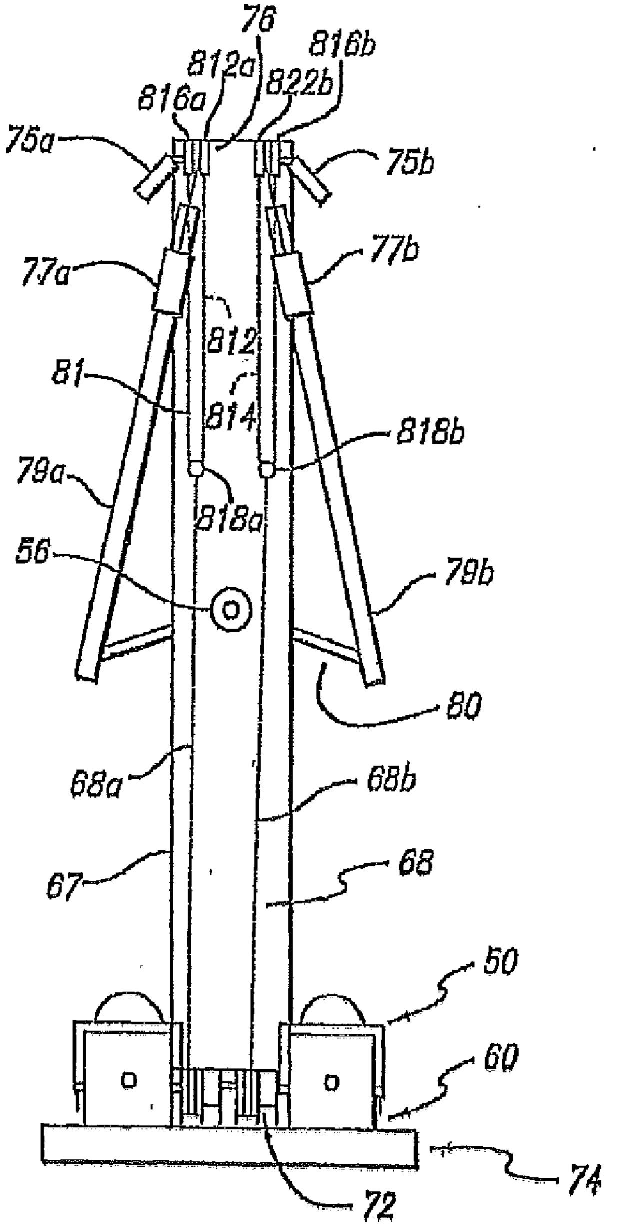

76
816b
812a
822b
816a
75a
75b
77a
77b
812
81
814
818b
79a
818a
56
79b
80
68a
68b
67
68
50
60
74
72

Fig. 8

Fig. 9

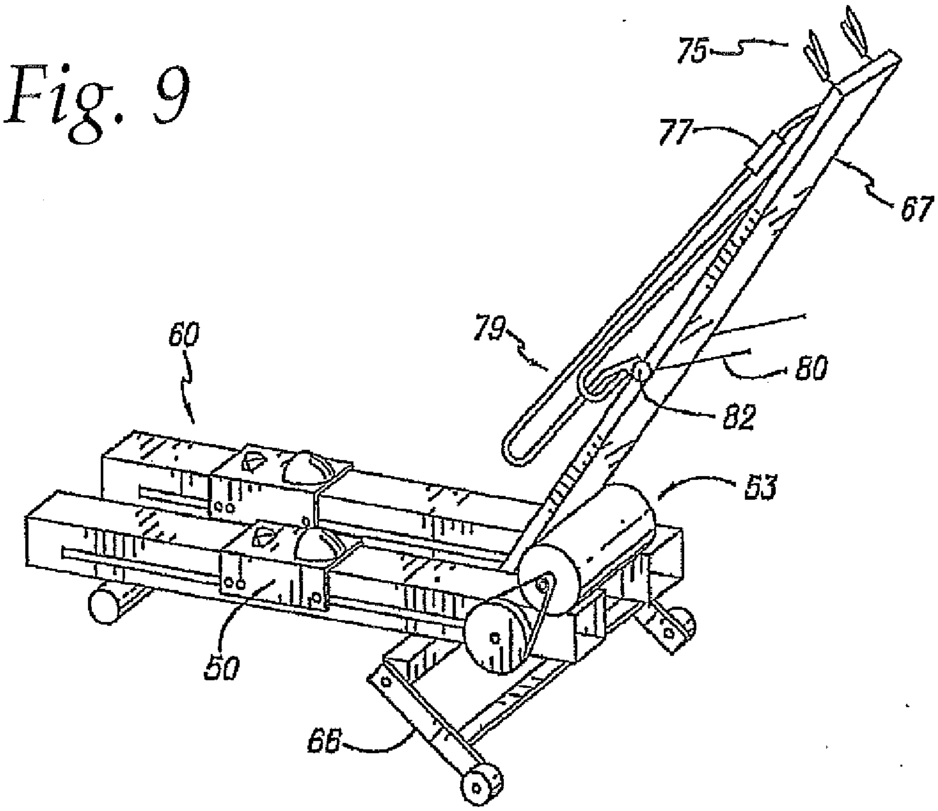
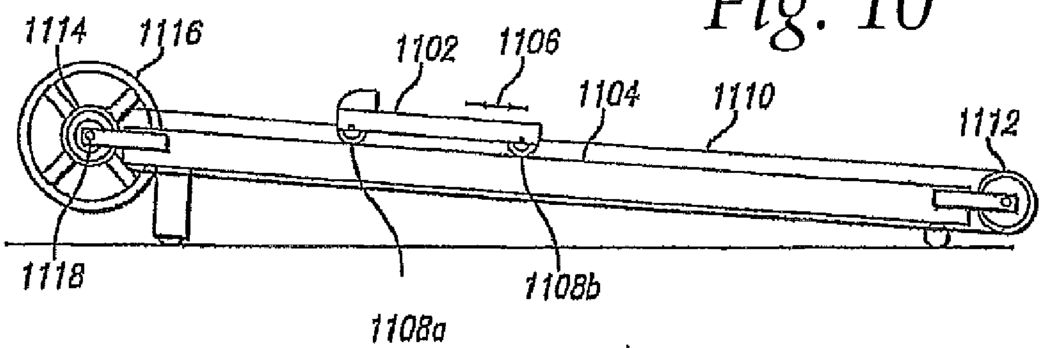


Fig. 10



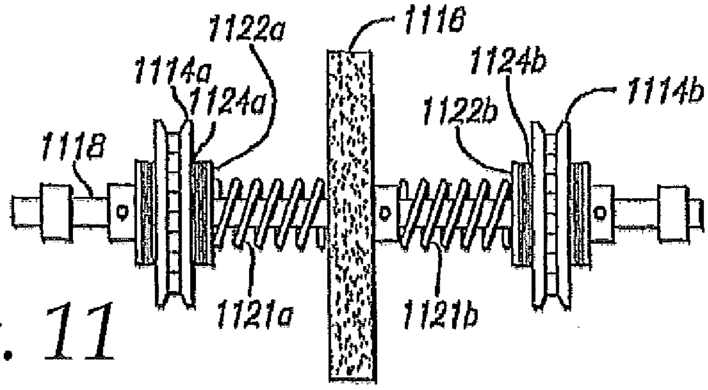
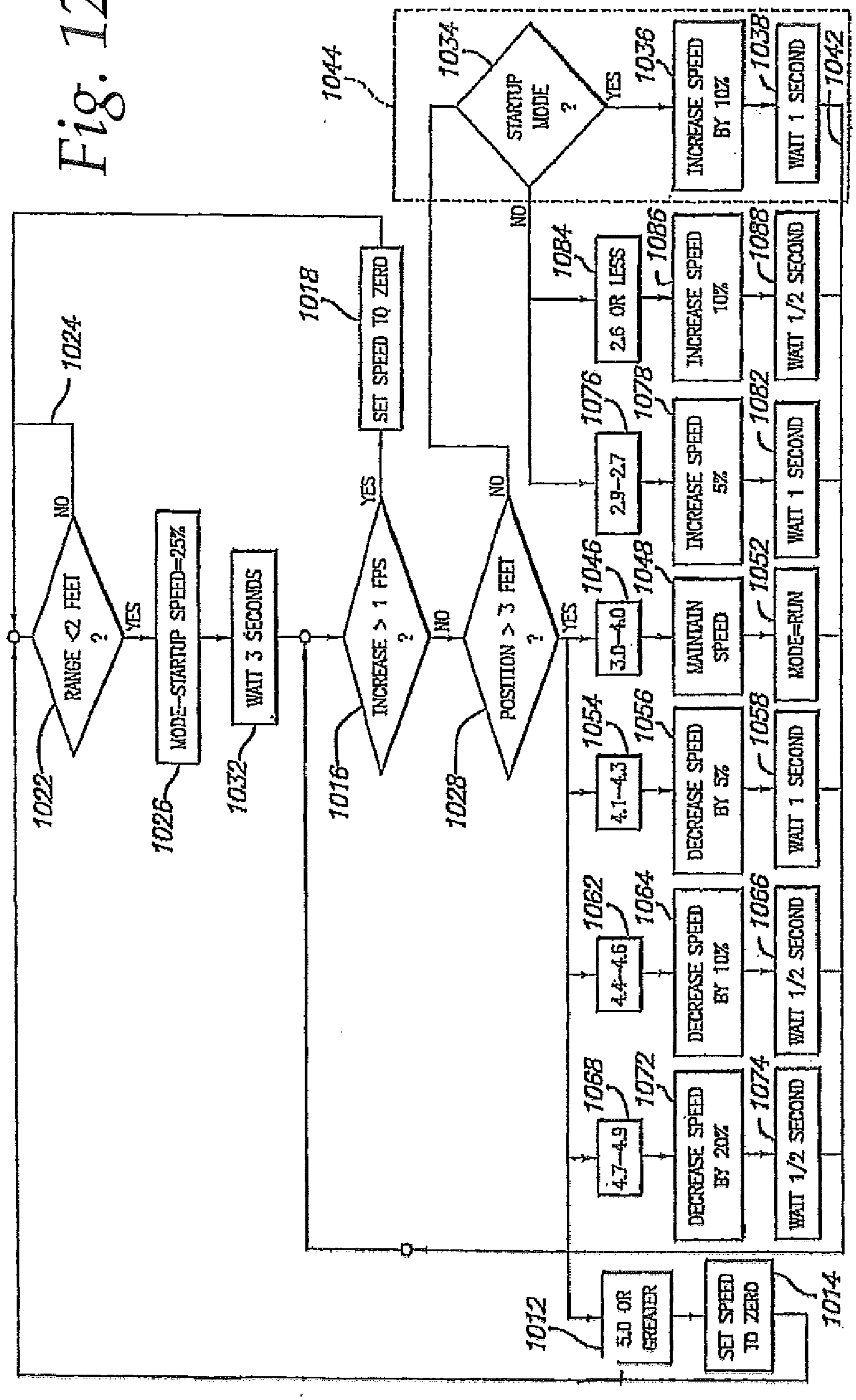


Fig. 11

Fig. 12


RANGE <2 FEET ?
YES
NO
1022
1024
MODE=STARTUP SPEED=25%
1026
WAIT 3 SECONDS
1032
INCREASE > 1 FPS ?
1016
SET SPEED TO ZERO
1018
POSITION > 3 FEET ?
1028
STARTUP MODE ?
1034
1044
INCREASE SPEED BY 10%
1036
WAIT 1 SECOND
1038
1042
2.6 OR LESS
1084
INCREASE SPEED 10%
1086
WAIT 1/2 SECOND
1088
2.9—2.7
1076
INCREASE SPEED 5%
1078
WAIT 1 SECOND
1082
3.0—4.0
1046
MAINTAIN SPEED
1048
MODE=RUN
1052
4.1—4.3
1054
DECREASE SPEED BY 5%
1056
WAIT 1 SECOND
1058
4.4—4.6
1062
DECREASE SPEED BY 10%
1064
WAIT 1/2 SECOND
1066
4.7—4.9
1068
DECREASE SPEED BY 20%
1072
WAIT 1/2 SECOND
1074
5.0 OR GREATER
1012
SET SPEED TO ZERO
1014

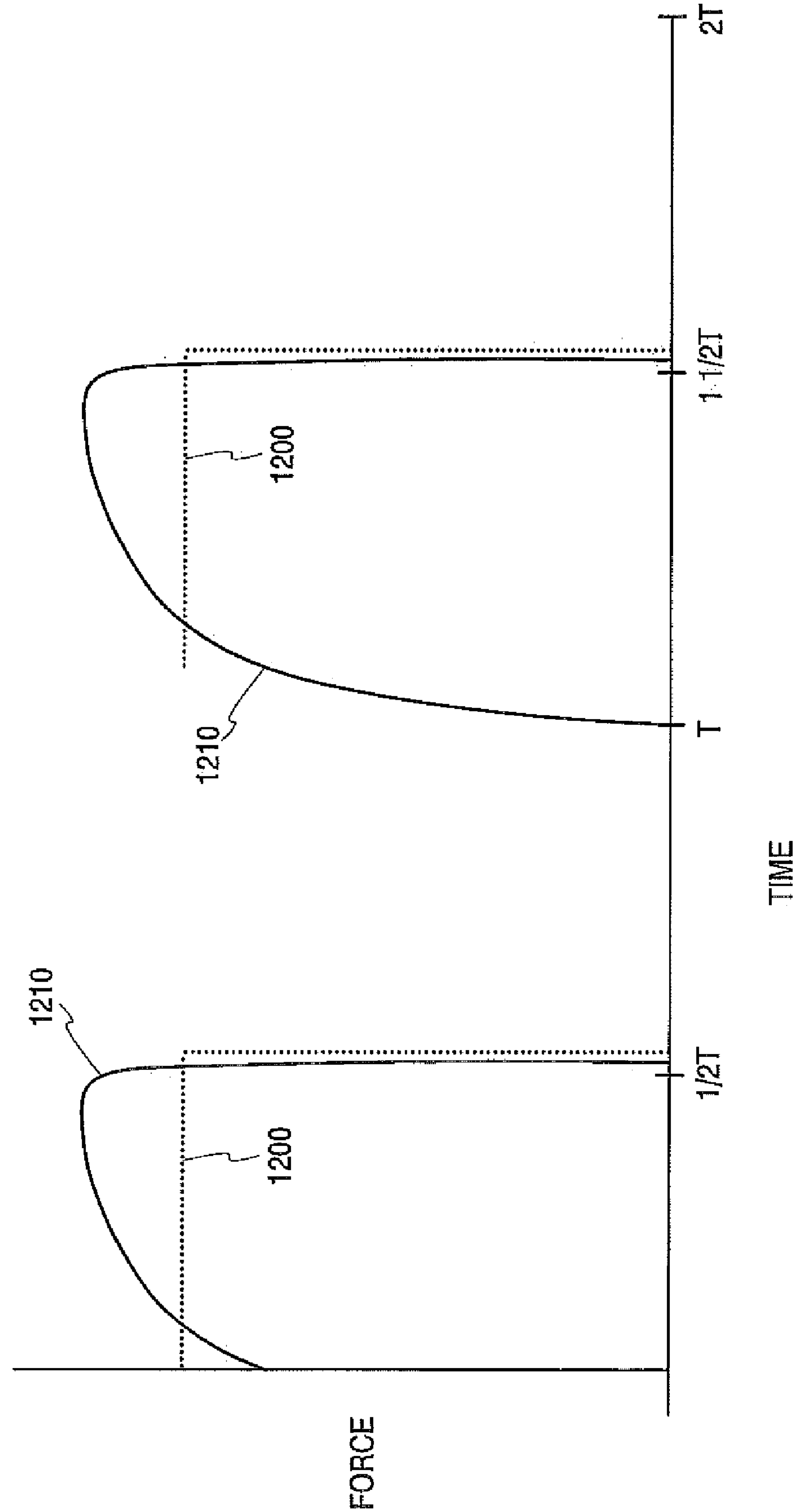
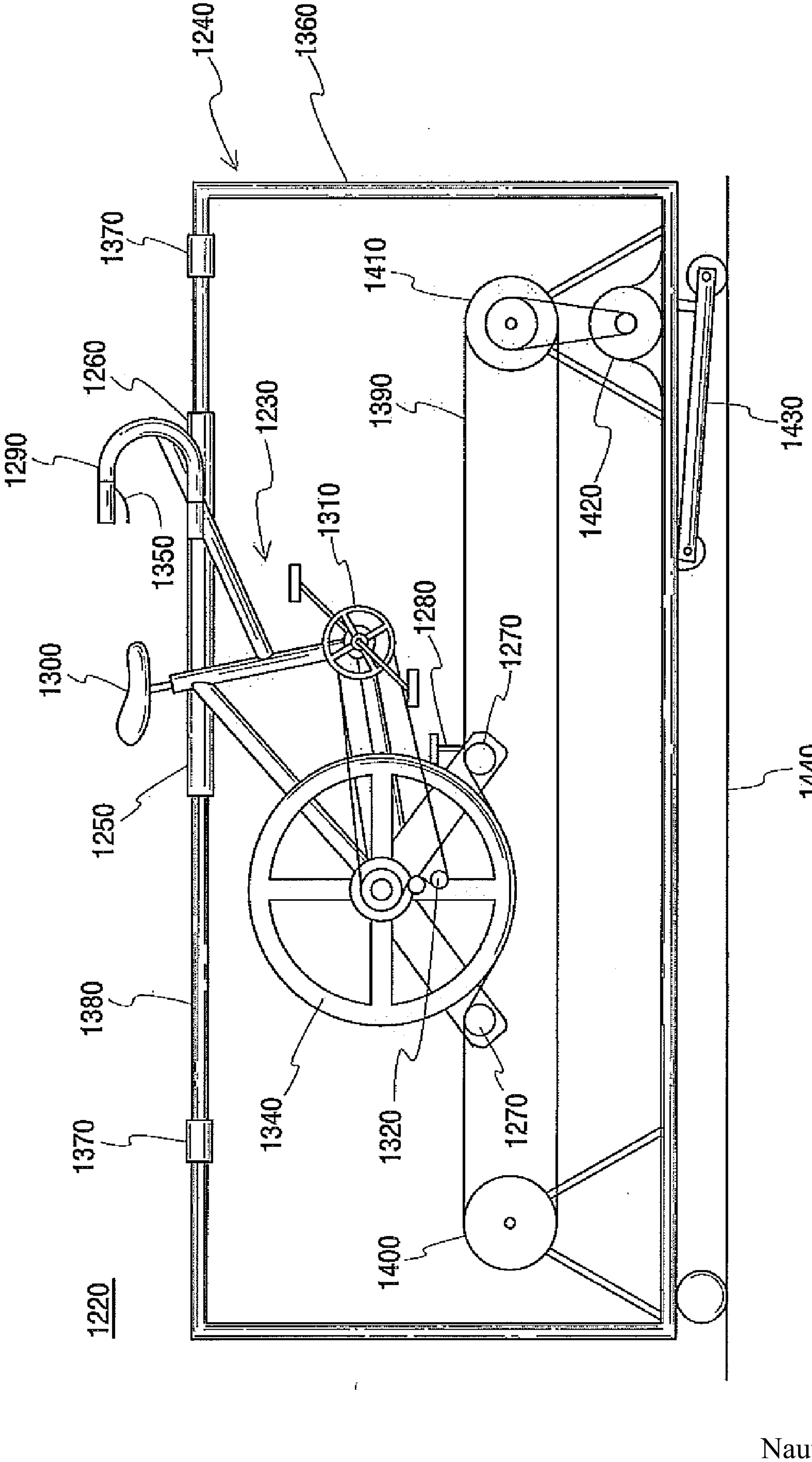


Fig. 13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1240
1360
1370
1260
1290
1350
1230
1310
1300
1250
1380
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1340
1320
1270
1270
1280
1400
1390
1410
1420
1430
1440

Fig. 14

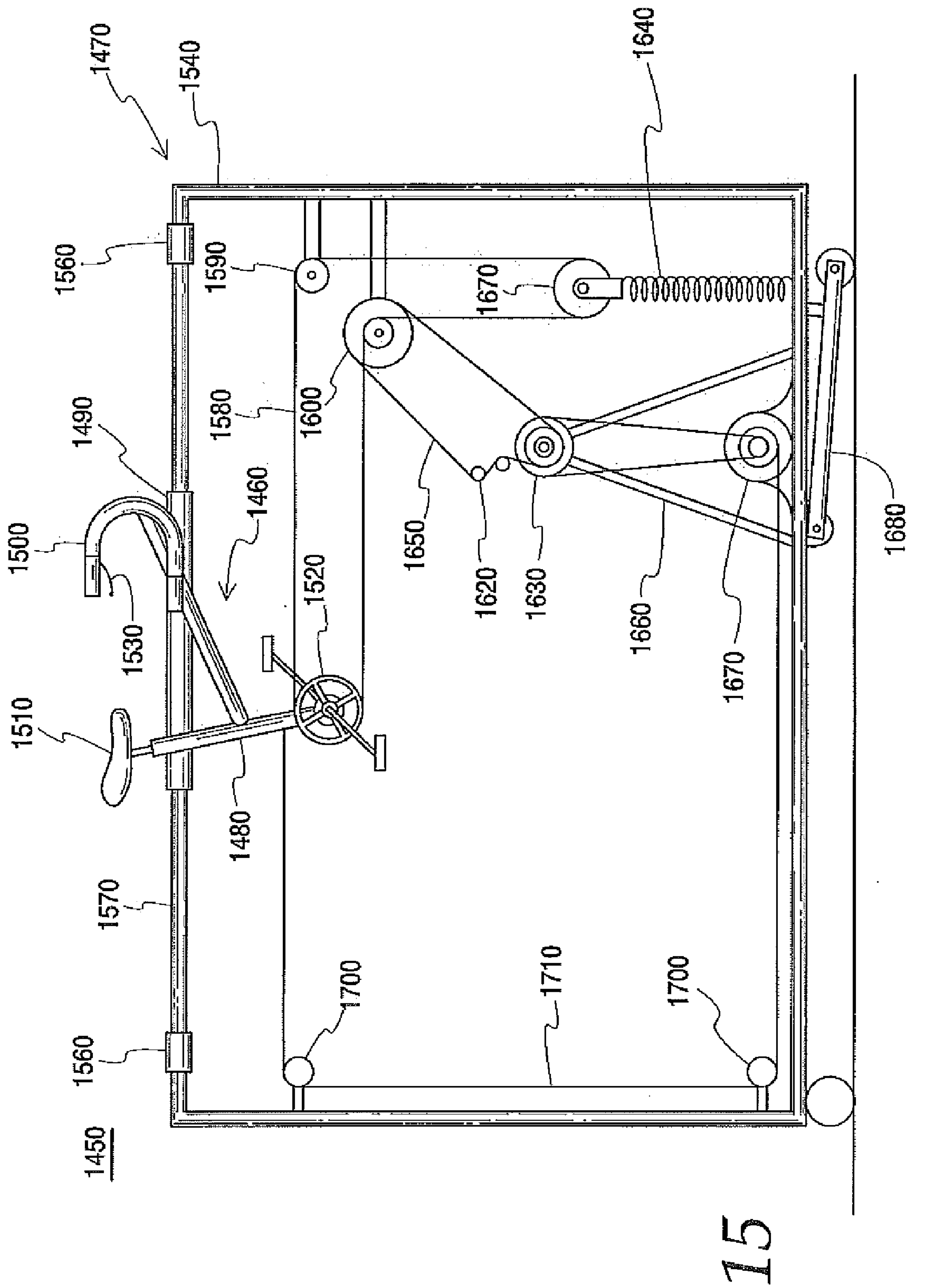

1470
1540
1640
1560
1590
1670
1600
1580
1490
1460
1500
1530
1520
1650
1620
1630
1660
1670
1680
1510
1480
1570
1700
1710
1700
1560
1450

Fig. 15

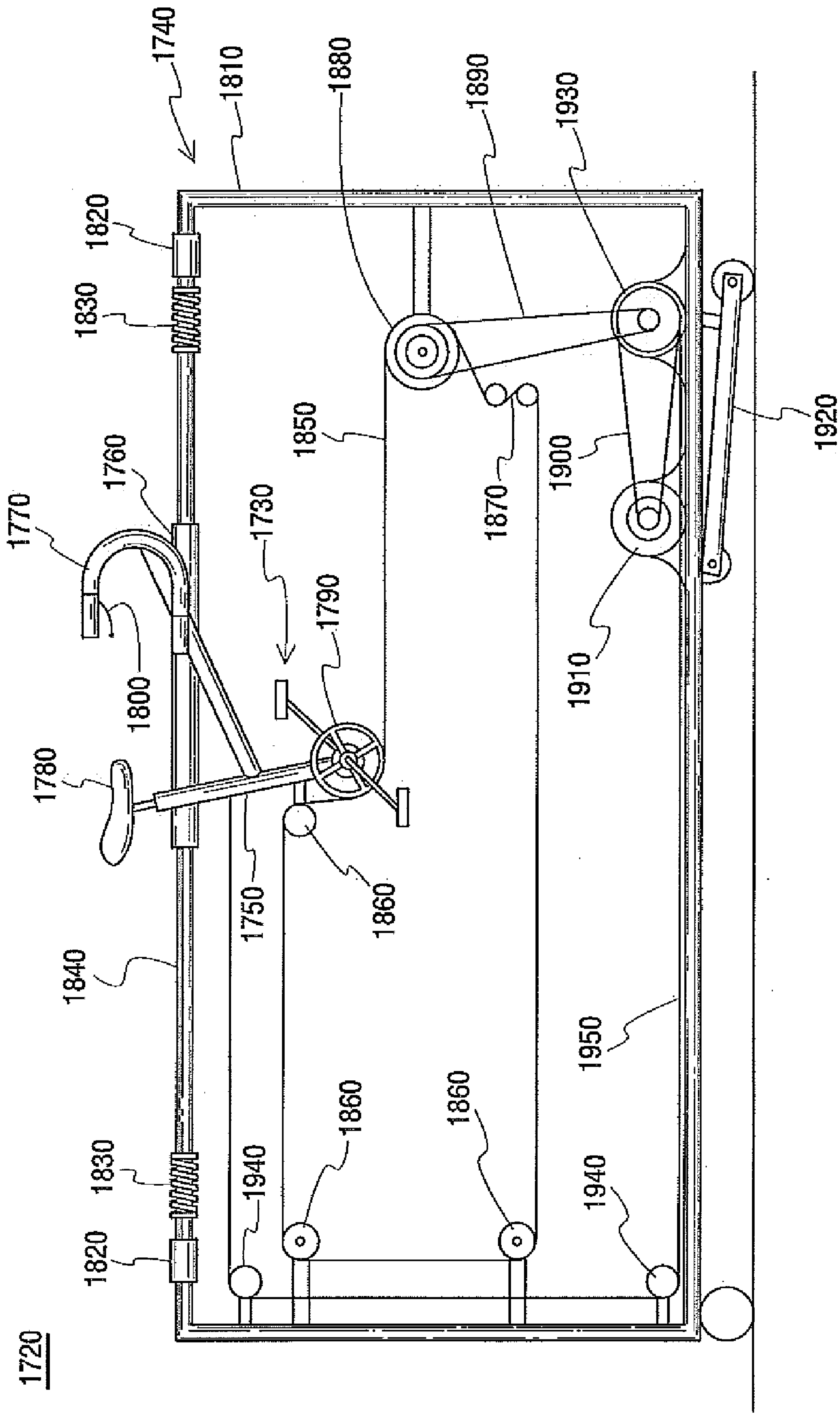

1720
1740
1810
1820
1830
1760
1770
1800
1780
1840
1830
1820
1730
1790
1750
1860
1850
1880
1870
1890
1930
1900
1910
1920
1950
1940
1860
1860
1940

Fig. 16

APPENDIX MM

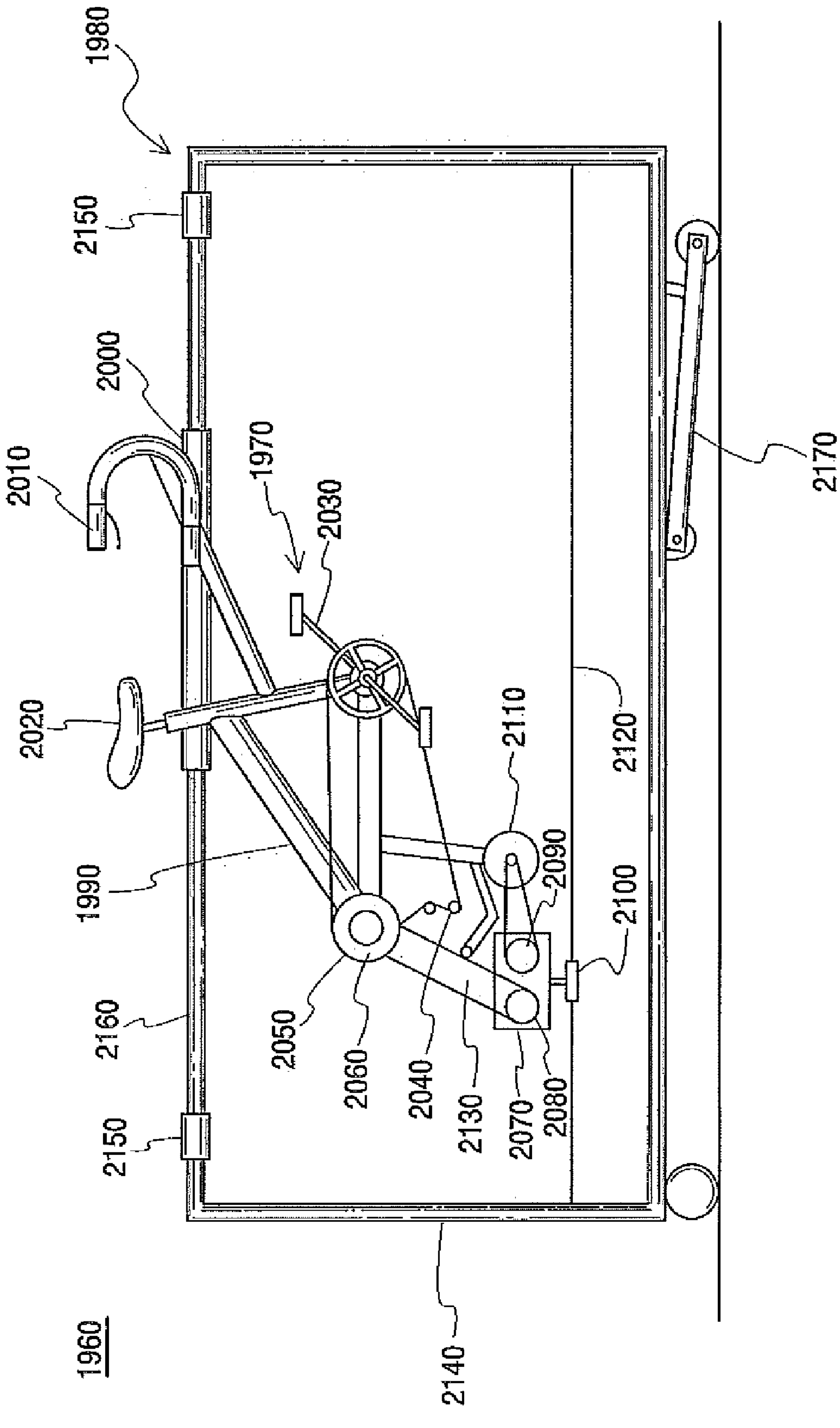


Fig. 17

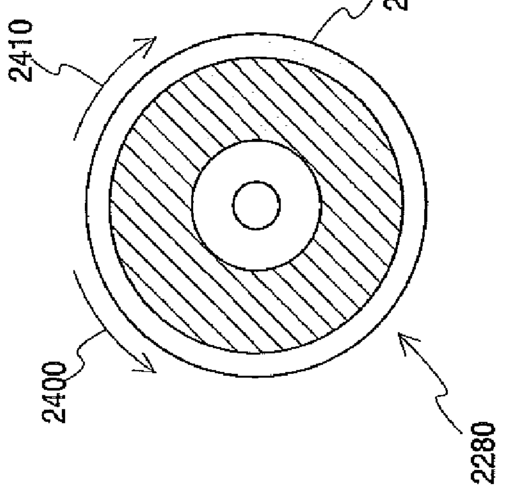

2410
2390
2400
2280

Fig. 19

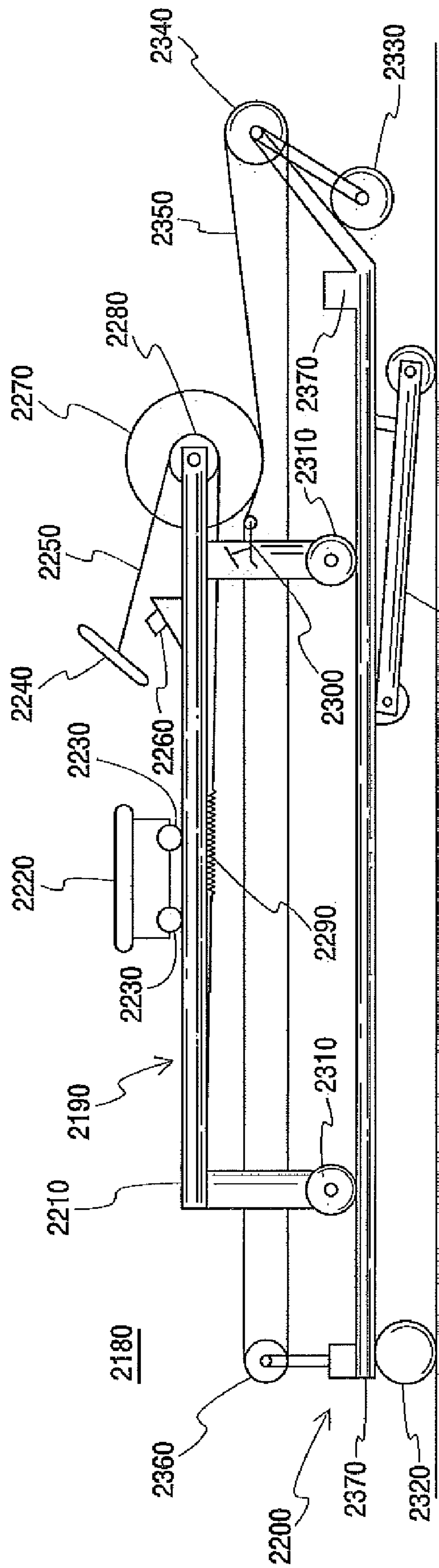

2340
2330
2350
2280
2370
2270
2310
2250
2380
2240
2260
2300
2230
2220
2290
2230
2310
2190
2210
2180
2360
2370
2320
2200

Fig. 18

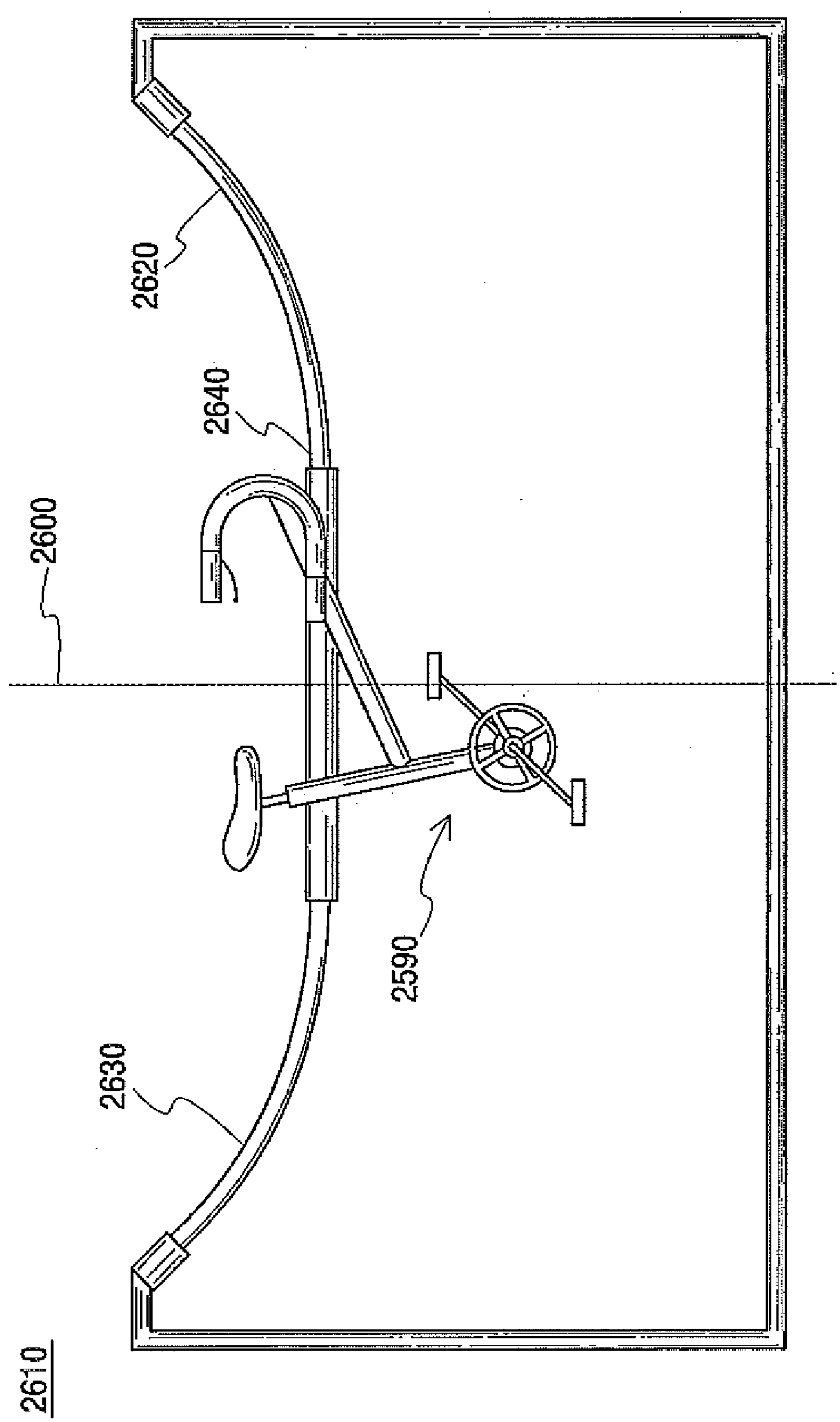


Fig. 20

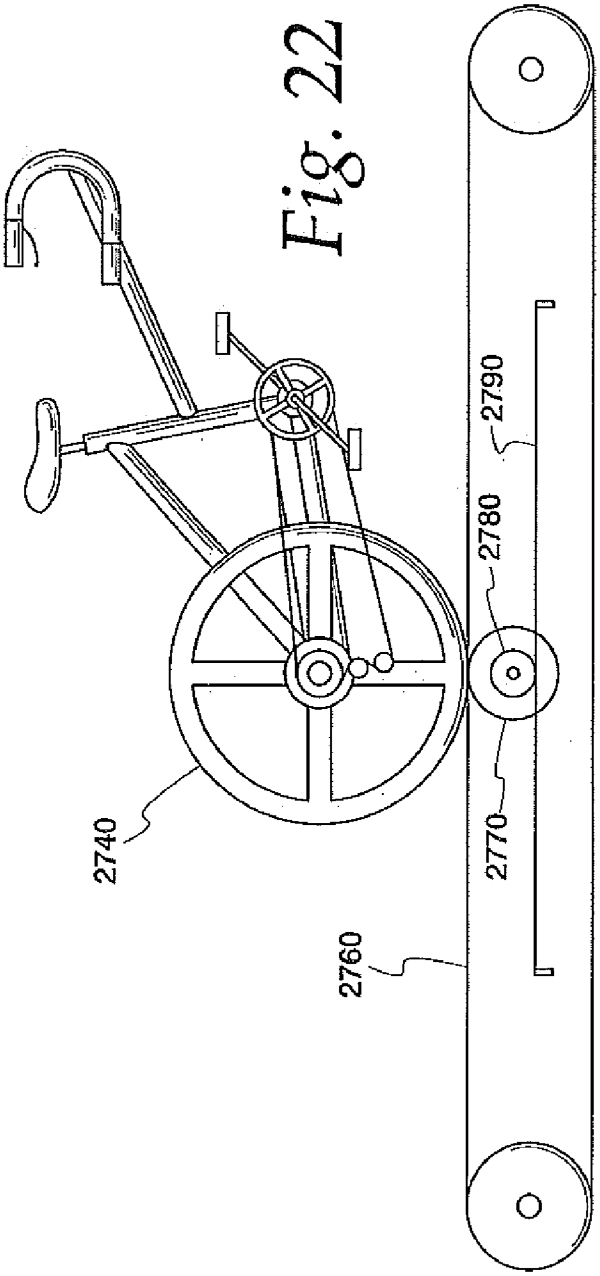

2740
2760
2770
2780
2790

Fig. 22

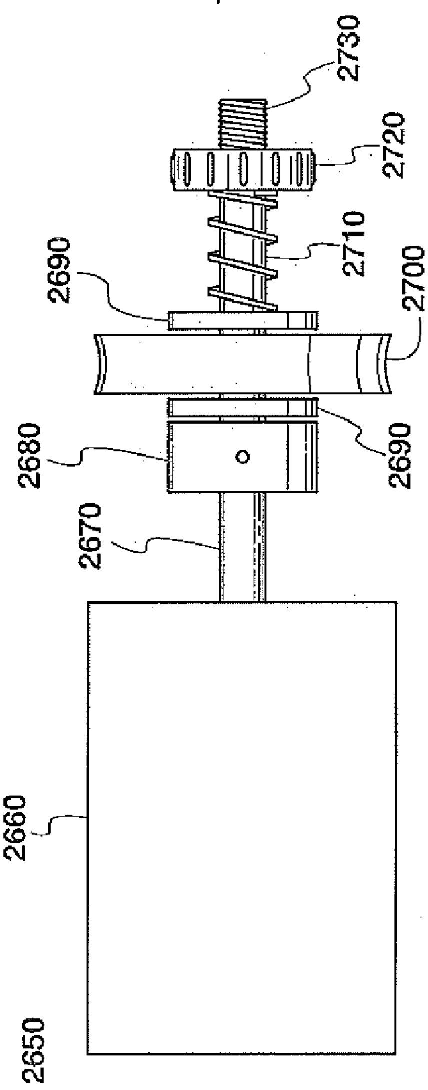

2650
2660
2670
2680
2690
2700
2690
2710
2720
2730

Fig. 21

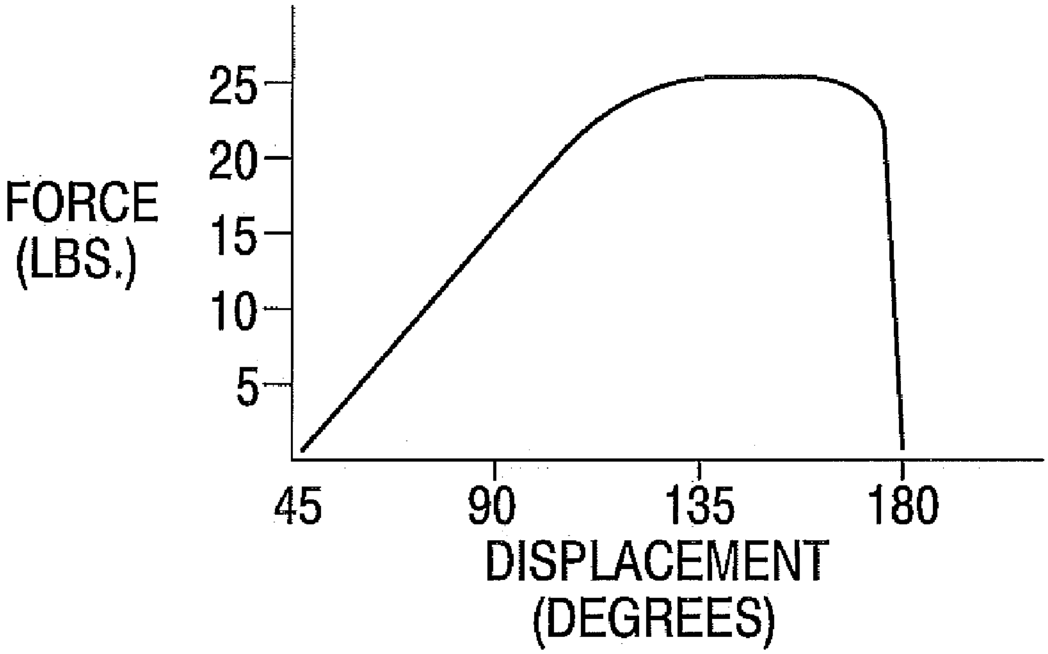

25
20
FORCE
(LBS.)
15
10
5
45
90
135
180
DISPLACEMENT
(DEGREES)

Fig. 23

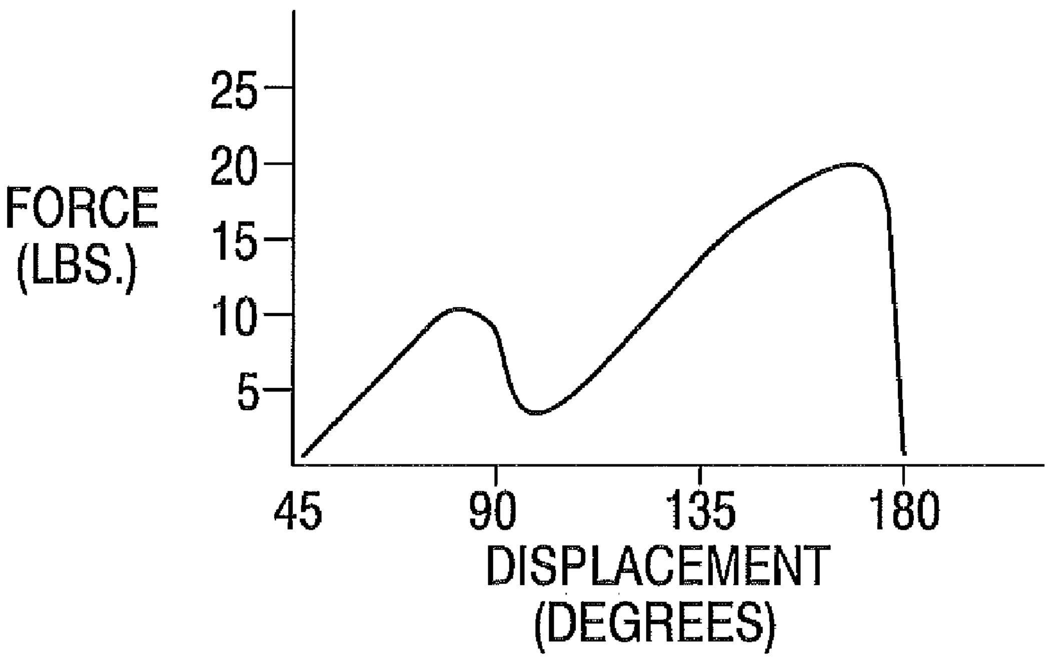

25
20
FORCE
(LBS.)
15
10
5
45
90
135
180
DISPLACEMENT
(DEGREES)

Fig. 24

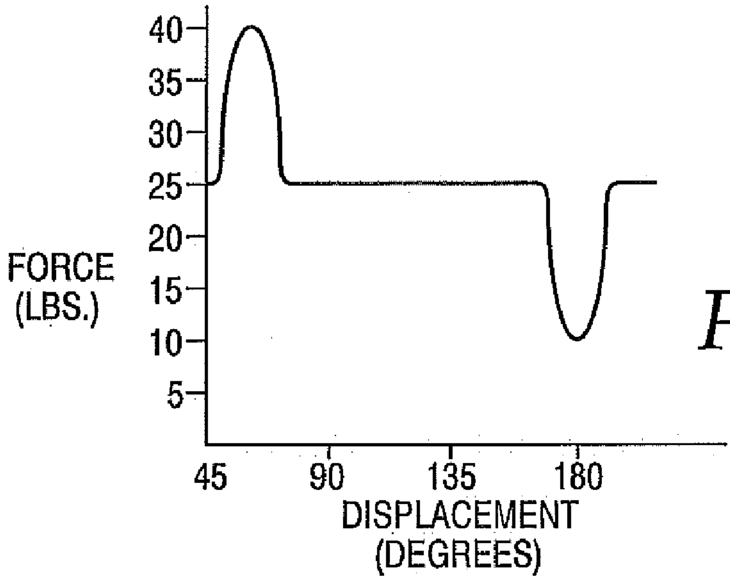


Fig. 25

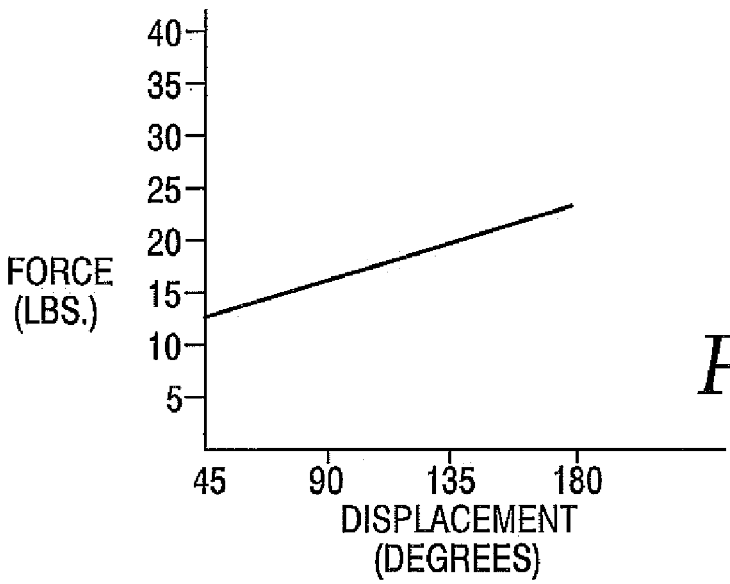


Fig. 26

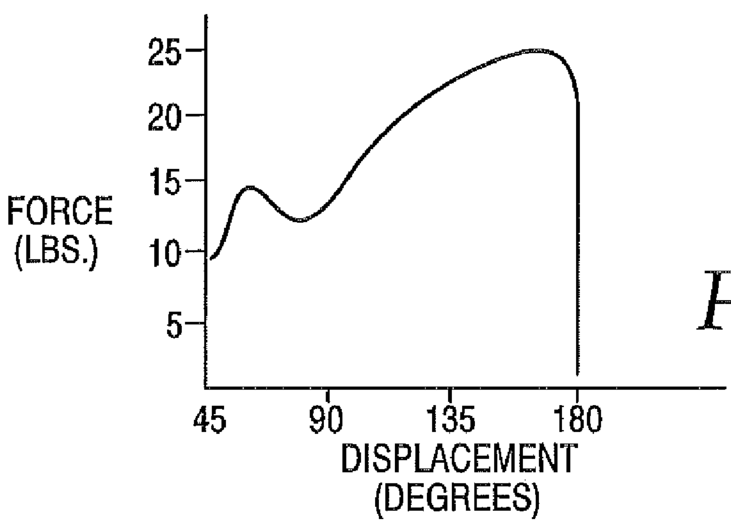


Fig. 27

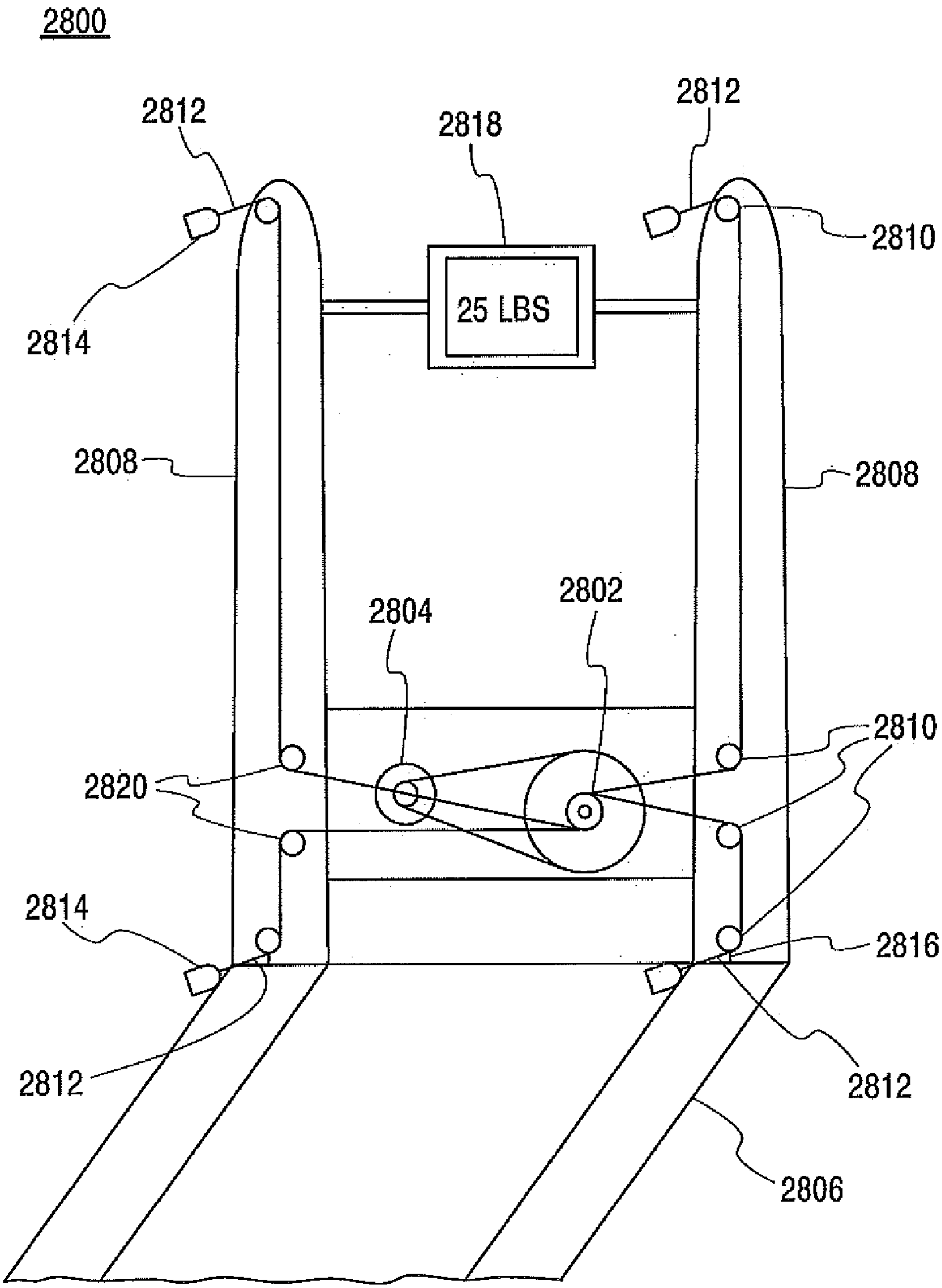

2800
2812
2818
2812
2810
25 LBS
2814
2808
2808
2804
2802
2810
2820
2814
2816
2812
2812
2806

Fig. 28

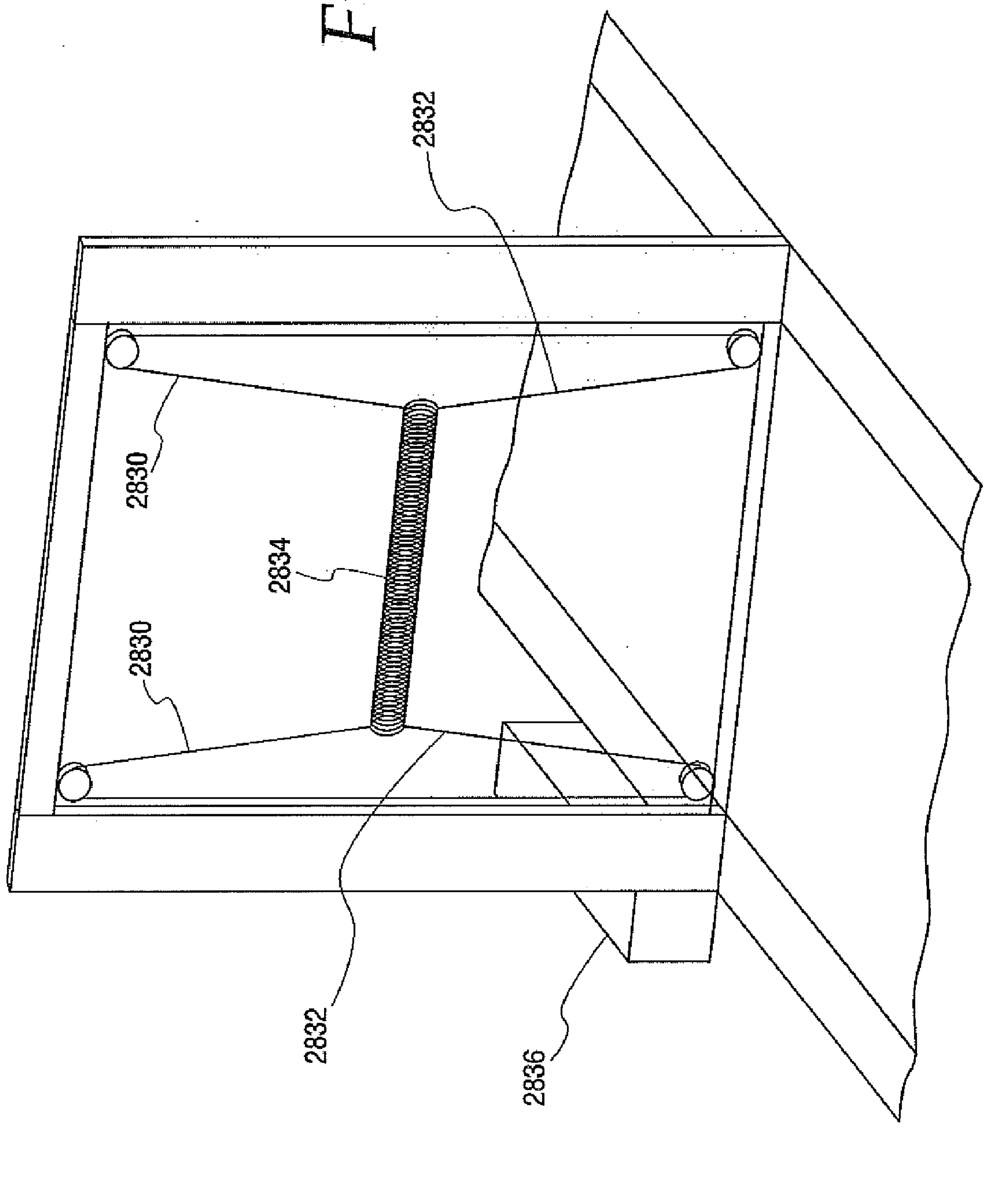


Fig. 29

Fig. 30a

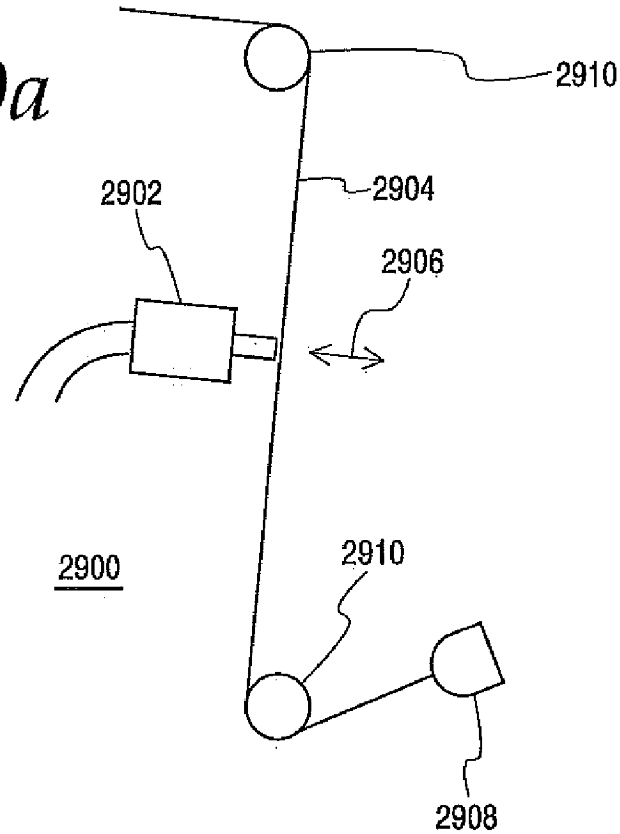
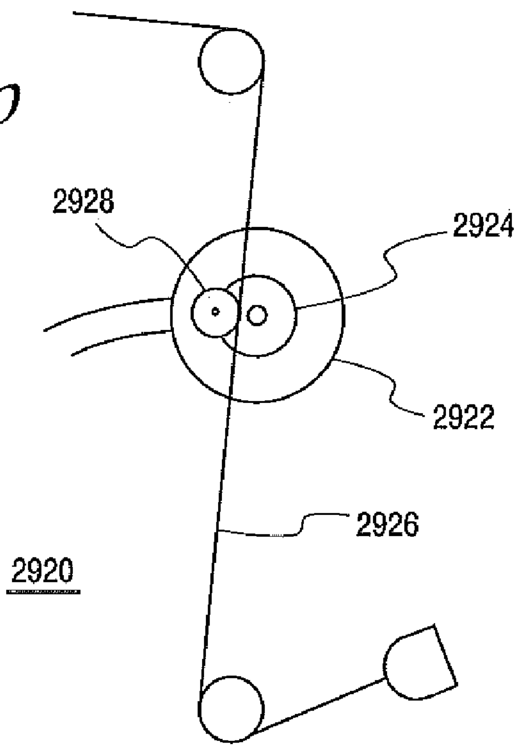


Fig. 30b



SPEED CONTROLLED STRENGTH MACHINE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims benefit as a continuation-in-part of application Ser. No. 12/420,928, filed Apr. 19, 2009, which claims benefit as a continuation of application Ser. No. 10/685,625 filed Oct. 15, 2003, now U.S. Pat. No. 7,179,205, which claims benefit under: (i) 35 U.S.C. 119(e) of U.S. Provisional Application, Ser. No. 60/418,461 filed Oct. 15, 2002; and (ii) as a Continuation-In-Part of application Ser. No. 09/977,123 filed Oct. 12, 2001, now U.S. Pat. No. 6,835,167, which is a continuation of application Ser. No. 08/865,235 filed May 29, 1997, now U.S. Pat. No. 6,302,829, which claims benefit of application Ser. No. 60/018,755 filed May 31, 1996.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to an apparatus for performing exercise and a method for using such apparatus and in particular to an apparatus which closely simulates many natural forms of exercise such as cross-country skiing, walking, running, biking, climbing and the like. The present invention further relates to an apparatus for replicating the reciprocating nature of motion during exercise, and more particularly to an apparatus for exercise, rehabilitation, amusement, and/or simulation of human-powered motion. The present invention further relates to an apparatus for strength training and in particular to an apparatus which addresses the natural physiology of the human body.

[0003] Many forms of natural exercise (i.e., exercise performed without the use of a stationary exercise machine) provide numerous benefits to an exerciser. In a number of types of natural exercise, a bilateral motion is performed of such a nature that in addition to the work done by a muscle group on one side of the body used, e.g., to attain forward motion in a motive type of exercise, there is simultaneously some amount of resistance to the muscle groups on the other side of the body, typically opposing types of muscle groups, so that both extension and flexion muscle groups are exercised. In a typical bilateral exercise such as cross-country skiing, the exerciser utilizes gluteus maximus and hamstring muscles in the backward stroke and, simultaneously, on the opposite side, quadriceps and hip flexor muscles in the forward stroke. Although various attempts have been made to simulate cross-country ski exercise or other bilateral exercise on a stationary exercise machine, these attempts have not been fully successful in reproducing the experience with sufficient accuracy to provide many of the health benefits of natural exercise. For example, in some ski-type exercise devices, while the trailing limb encounters resistance, the opposite limb encounters virtually no resistance (typically only resistance from fiction of moving machine parts). As a result, many such previous devices include a feature intended to counteract the force of the backward thrusting limb, such as an abdomen pad which receives the forward thrust of the exerciser's body as the exerciser pushes backward against resistance with each leg in an alternating fashion. This abdominal pad keeps the user in a stationary fore/aft position. It is believed that in such (stationary) machines, pushing against the abdominal pad can lead to lower back stress and fatigue and detracts from an accurate simulation of the natural cross-country ski exercise. It is further believed that the lack of forward resistance and the associated lack of balance in such devices lead to a long learning curve such that, to successfully use the machine, a user must develop a new technique for walking or skiing which is very different from that found in nature.

[0004] Another feature of many natural bilateral exercises such as skiing, walking, running, jogging, bicycle riding, etc., is that while the exerciser may on average move forward at a constant velocity, the exerciser momentarily accelerates and decelerates as he begins and ends each stroke. As a result, in many natural bilateral exercises, although the exerciser maintains a constant average speed, in fact if one were to travel alongside the exerciser at such constant speed, the exerciser would appear to be oscillating forward and backward with respect to the observer. This constant change in velocity is natural to most forms of human propulsion by virtue of an alternating stride while walking, running, bicycling, etc.

[0005] Again, it is believed that many stationary exercise devices fail to reproduce this feature of the natural exercise with sufficient accuracy to provide an enjoyable exercise experience and to provide all the benefits available with natural exercise, such as a more natural and less stressful distribution of force on the joints and development of good balance. For example, with the above-described ski exercise machine, the exerciser is typically pushing against the abdominal pad during substantially most or all of the exercise, thus causing the exerciser to stay in substantially the same position rather than accelerate and decelerate in an oscillating manner as in natural skiing.

[0006] A number of forms of natural exercise provide benefits to the upper body as well as the lower body of the exerciser. For example, in cross-country skiing, the exerciser typically pushes using poles. A number of features of the upper body exercise in natural exercise settings are of interest in the context of the present invention. For example, during cross-country skiing, the arm and leg motions are related such that if a skier wishes to maintain constant average speed, exerting greater upper body effort ("poling" with the arms) results in less effort being exerted by the legs, and vice versa. Further, in cross-country skiing, although the arm and leg energy exertions are related, the left and right upper body exertions are independent in the sense that the user does not need to pole in an alternating fashion, much less a fashion which is necessarily synchronized with the leg motions. A cross-country skier may "double pole", i.e., pushing with both poles at the same time, or may, if desired, push with only a single pole or no poles for a period of time. Another feature of cross-country skiing is that while the skier is moving, when a pole is plunged into the snow, the pole engages a resistance medium which relative to the skier is already in motion, thus providing what may be termed "kinetic resistance".

[0007] Many types of previous exercise devices have failed to provide a completely satisfactory simulation of natural upper body exercise. For example, many previous ski devices provided only for dependent arm motion, i.e., such that the arms were essentially grasping opposite ends of the rope wound around a spindle. In such devices, as the left arm moved backward, the right arm was required to simultaneously move forward substantially the same amount. Thus it was impossible to accurately simulate double poling or poling with a single arm. Many previous devices provided upper body resistance that was entirely unrelated to lower body resistance. In such devices, if an exerciser was expending a given level of effort, by exerting greater upper body efforts, the user was not, thereby, permitted to correspondingly decrease lower body exercises while maintaining the same overall level of effort. Many previous devices having upper body resistance mechanisms provided what may be termed "static resistance" such that when the arm motion began, such as by thrusting or pushing, or pulling backward with one arm, the resistance device was being started up from a stopped position, typically making it necessary to overcome a coefficient of static friction and detracting from the type of kinetic or dynamic resistance experienced in the natural cross-country ski exercise.

[0008] Many types of exercise devices establish a speed or otherwise establish a level of user effort in such a fashion that the user must manually make an adjustment or operate a control in order to change the level of effort. Even when an exercise device has a microprocessor or other apparatus for automatically changing levels of effort, these changes are pre-programmed and the user cannot change the level of effort to a level different from the pre-programmed scheme without manually making an adjustment or providing an input to control during the exercise. For example, often a treadmill-style exercise machine is configured to operate at a predetermined level or series of pre-programmed levels, such that when the user wishes to depart from his or her predetermined level or series of levels, the user must make an adjustment or provide other input. In contrast, during natural exercise such as biking, the user may speed up, slow down, change gears, or rest at will.

[0009] Additionally, current human motion simulating machines such as exercise bikes, skiers, rowers, etc. have one very important aspect in common; they are considered stationary machines. In other words, the platform on which the user sits or stands is fixed in location. As discussed below, this stationary aspect prevents these devices from realistically exhibiting the sensation of natural motion.

[0010] When a person propels a bicycle, cross country skis, row boat, etc., there are subtle fore and aft motions encountered by both the person and the vehicle. Although the amplitude and duration of these motions are somewhat specific to a particular vehicle, they are all tied directly to the force output generated by the person propelling the vehicle. For example, when a person rides a bicycle, these subtle motions occur as a result of his pedaling, and the reciprocating action of the user's legs is what ultimately motivates the bicycle in a forward direction. When closely examining the physics behind the forward motion of a bicycle it becomes apparent that the bicycle and user are in a continual state of acceleration and deceleration while the user pedals. This is due to the fact that when the user exerts a force on one of the pedals, the bicycle and user accelerate until that pedal begins to approach the bottom of its stroke, at which point the bicycle and user begin to decelerate. As the opposite pedal reaches the top of its stroke, this cycle begins again. As a result, the cyclist is in a constant state of acceleration and deceleration. This oscillating motion can be easily witnessed by driving in a car at a constant speed along side a cyclist. From the perspective of an occupant of the car looking out a side window, the rider will appear to move fore and aft in a manner directly related to his pedaling cadence. This fore and aft movement will generally be between a range of one-half of an inch on level or downhill terrain to several inches on an uphill grade.

[0011] When a rider encounters a hill, he generally changes the gear ratio of his bike by "changing gears" such that a lower ratio is used. The rider can therefore maintain the same cadence and force output as he would on level ground resulting in a slower speed up hill. For example, it is the goal of a profession cyclist to maintain a relatively steady cadence, normally 80-100 strokes per minute. This is the case whether riding on level terrain, uphill or downhill. The use of a gearing system ensures that a constant cadence is maintained, even though the speed of the bicycle may vary drastically.

[0012] The use of a gearing system also affects the motion of the vehicle being ridden. For example, the fore and aft oscillation of a bicycle is much greater in low gear vs. high gear due to the increased torque applied to the drive wheel. As a result, in low gear there is much less stress on the leg joints and muscles. This is particularly important in physical therapy and rehabilitation. For example, a person recovering from reconstructive knee surgery may be advised by a physician to exercise the knee with very low exertion. In this case, it would be advantageous for the person to exercise on a bicycle in a low gear ratio to reduce stress on the recovering knee.

[0013] An important aspect of natural human motion is the concept of rest. For example, during the deceleration phase of the oscillation described above, the muscles experience a short period of rest. This rest period increases as the period of oscillation increases. When a rider pushes a pedal once every few seconds, the bicycle coasts during the rest periods.

[0014] Current exercise bicycles generally include a user seat on a frame with a set of pedals which spin a flywheel. The flywheel is magnetically or otherwise braked to give resistance to the user's legs. These machines generally simulate hill climbing by simply adding greater resistance to the flywheel which requires either a greater force output or slower pedaling cadence by the user and adds increased pressure to the legs and joints. The stationary nature of these machines precludes the user from experiencing the fore and aft motion encountered while using a real bicycle. Instead, although the user's body strains to oscillate forward and backward, the stationary aspect of the machine keeps him fixed in one place. This causes a jerky sensation which translates into an uncomfortable and non-motivating activity, as well as the potentially dangerous wear and tear on the user's joints and muscles.

[0015] The solid line in the chart of FIG. **13** depicts the force exerted by a user's foot on the pedal of an actual bicycle during a pedal stroke. From this chart, it becomes apparent that the forward acceleration of the bicycle and rider reduces the initial force exerted against the pedal when the knee is bent the most. This greatly reduces the stress to knee and leg muscles when compared to a stationary bike which requires the user's full force from the very beginning of the stroke. See the dashed line of FIG. **13**.

[0016] Similar principles apply to the activity of natural rowing when compared to the use of a stationary rowing exercise machine. When rowing a boat with a sliding seat, the user straps his feet to a stationary part of the boat and sits on a seat facing rearward which can slide fore and aft. At the beginning of the stroke, the user bends his knees so as to bring his body toward the rear of the boat. He then extends his arms fully and engages the oar blades into the water. Next he straightens his legs and pulls the oars toward his torso. At the end of each stroke, the user pulls the oar blades out of the water and returns to the beginning of his stroke to start the sequence again.

[0017] As with the bicycle, a person following alongside a rower at a steady speed will observe the boat and user oscillating fore and aft with each stroke. As the user engages the oar blades and begins his stroke (the power stroke), the boat and user accelerate forward. When the user reaches the end of his stroke and returns (return stroke) to the starting position, the boat and user decelerate. Relative to the observer, this oscillation will be considerably greater than that of a bicycle, and, depending on the amount of time the user takes on his return stroke, may exceed one foot.

[0018] Most rowing exercise machines confine a user to a fixed location, i.e. the user's feet are strapped to a stationary pad. These designs don't allow for any fore and aft movement of the user's body other than the sliding of the seat. This results in a jerking sensation at the beginning and end of each stroke. These rowing machines can cause strain on the back and legs and over-compression of the knees. See FIG. **13**.

[0019] These stationary exercise bike and rower examples demonstrate the need for a more realistic exercise machine capable of accurately replicating the forces of nature as they apply to human powered locomotion devices. The present invention overcomes the above-mentioned obstacles and can be applied to any type of exercise device which uses the reciprocating nature of human motion such as a bike machine, a rowing machine, a cross-country ski machine and any other reciprocating motion apparatus and the like. The present invention can be likened to a human propelled differential motion machine, much like the differential on an automobile. In particular, a dynamic element moves in one direction (input **1**), the user mounts a carriage and motivates a drive wheel (or the like) in the opposite direction (input **2**), and the user and carriage move based on the difference between the two inputs, or the differential.

[0020] Along with providing a more realistic machine for accurately replicating the forces of nature as they apply to cardiovascular exercise devices, the present invention also provides a similarly realistic machine for accurately maximizing strength exercise. Coupled with cardiovascular training, strength training is an important part of maintaining optimal physical fitness.

[0021] Strength training involves applying a force against a resistance over a range of motion. Human anatomy limits the amount of force a user can produce at any one position throughout this range, and the magnitude of force which can be safely applied at any point can vary considerably.

[0022] For example, when exercising the triceps muscles, a person begins with forearms flexed at the elbows (e.g. 45 degrees) and pushes against a resistance until the elbows are fully extended (e.g. 180 degrees). The lever arm at the elbow where the triceps attaches to the forearm is shorter during flexion than during extension. As a result, a person's force output capability increases as the forearm is extended. See FIG. **23**. A functional triceps exercise would therefore apply a variable force, starting low at the beginning of the stroke and increasing throughout extension.

[0023] As such, some forms of strength training can feel unnatural and even cause injury. An injury can further complicate the optimal force which an individual can apply during the range of motion. For example a person with tendonitis of the elbow may feel the greatest discomfort halfway through the range of motion (e.g. 112.5 degrees). The optimal force output for this person might be 5 lbs at 45 degrees, 10 lbs at 72 degrees, 3 lbs at 99 degrees, 10 lbs at 126 degrees, 20 lbs at 153 degrees and 18 lbs at 180 degrees. See FIG. **24**.

[0024] Lifting weights is one of the most popular forms of strength training This can involve lifting free weights, using linkages or cables attached to weights. Weight lifting involves lifting and lowering a fixed weight. The profile of the force application to the user is counterintuitive. For example, a weight bearing cable pull-down exercise performed for exercising the triceps generally involves running a cable over a pulley at head level and down to a fixed weight. The user grasps a handle on the other end of the cable, suspends the weight with elbows fully flexed, and then begins the motion of extending the upper arms downward until full extension is achieved. He then returns to the flexed position and repeats the move.

[0025] Assuming the use of a 25 lb. weight, the force applied to the user prior to beginning the move is 25 lbs. At this point the weight is hanging, but not moving. As soon as the user begins the motion, he has to accelerate the weight from a stopped position causing a brief impulse force (F=ma). This impulse force will generally range from 25% to 50% of the weight being used and its effect is added to the weight itself. Once the weight is up to speed, the force drops to 25 lbs., and as the user reaches the end of the stroke and decelerates the weight, there is a negative impulse force (force reduction). As a result, the user experiences a force of as much as 37.**5** lbs. at his weakest position, and as little as 12.5 lbs. at his strongest position. See FIG. **25**.

[0026] Spring resistance is another form of strength training. Using linkages or cables attached to springs, these machines allow users to exercise a variety of muscle groups. Spring loaded strength exercisers generally rely on winding a spring throughout the range of motion. In this case, the force application generally begins at some predetermined amount and then increases throughout the range of motion based on the spring constant. See FIG. **26**.

[0027] Flywheel/resistance based machines, utilizing linkages or cables to allow the user to exercise, are yet another form of strength training. These machines can offer a complex variety of forces depending on speed and frequency repetition. These machines generally utilize a speed dependant resistance mechanism such that the faster the user pulls, the greater the resistance. The force application also includes a "tare" component necessary to power the device and keep the flywheel rotating. See FIG. **27**.

[0028] Most strength training machines/techniques require a user to choose a weight or resistance based on the weakest point throughout his range of motion. This limits the effectiveness of the workout by not taxing the muscles enough during the stronger points throughout the range of motion.

[0029] Additionally it becomes "hit or miss" when trying to determine the maximum force a user can apply. For example, determining the maximum weight that can be bench pressed requires the user to try consecutively larger amounts until the weight cannot be lifted. Going through this process weakens the user with each consecutive try which makes the results unreliable.

[0030] The above mentioned forms of strength exercise cannot address the natural physiology of the human body. Additionally, the complex profile of the ideal force applied over the range of motion (functional strength training) not only varies from one exercise to another or one person to another, but from one repetition to another.

[0031] Accordingly, it would therefore be advantageous to utilize a strength exercise which allows the user to apply a varying force of his choosing throughout the range of motion.

[0032] It is a general objective of the present invention to provide a speed controlled strength machine such that resistance (torque) is user dependent.

[0033] It is another general object of the present invention to provide a strength exercise machine which allows a user to exercise in a functional manner with improved safety and effectiveness.

[0034] It is another object of the present invention to provide a strength exercise machine which allows a user to easily determine their maximum force output at any given time.

[0035] It is a more specific object of the present invention to provide a strength exercise machine which allows a user to vary the force output at any time throughout the range of motion.

[0036] Yet another object of the present invention is to provide a strength exercise machine which allows a user to alternate from one strength exercise to another without making any adjustments to the machine.

[0037] Yet another object of the present invention is to provide a strength exercise machine which allows the user to apply a different amount of force from limb to limb.

[0038] Yet another object of the present invention is to provide a strength exercise machine which allows the user to exercise at various speeds.

[0039] Another object of the present invention is to provide a strength training exercise machine which displays the amount of force being produced by the user at any point throughout the range of motion.

[0040] Another object of the present invention is to provide a strength exercise machine which displays a workout regimen to coach the user from one strength exercise to the next.

[0041] Yet another object of the present invention is to provide a strength exercise machine which allows opposing muscle groups to be exercised simultaneously.

[0042] Another object of the present invention is to provide a strength exercise machine which displays speed of motion, number of repetitions and range of motion.

[0043] These and other objects, features and advantages of the present invention will be clearly understood through a consideration of the following detailed description.

SUMMARY OF THE INVENTION

[0044] An exercise apparatus is provided including a frame. A driver is mounted to the frame and includes an adjustable speed controller for controlling a constant predetermined speed. User engageable grips are attached to the driver through one-way clutches such that the clutches engage the driver when the user reaches the predetermined speed through use of the grip during exercise.

BRIEF DESCRIPTION OF THE DRAWINGS

[0045] The features of the present invention, which are believed to be novel, are set forth with particularity in the appended claims. The invention, together with the further objects and advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawings, in the several figures of which like reference numerals identify like elements, and in which:

[0046] FIG. **1** depicts a side view of an apparatus according to one embodiment of the present invention;

[0047] FIG. **2** is a top plan view (partial) of the apparatus of FIG. **1**;

[0048] FIG. **3** is a top plan view similar to the view of FIG. **2** but showing a first alternate speed control mechanism;

[0049] FIG. **4** is a top plan view similar to the view of FIG. **2** but showing a second alternate speed control mechanism;

[0050] FIG. **5** is a side elevational view of an exercise apparatus according to an embodiment of the present invention;

[0051] FIG. **5**A is a side elevational view of the device of FIG. **5**, but showing the device configured for increased inclination and with the arm rails extended;

[0052] FIG. **6** is a partial exploded perspective view of a footcar and conveyor belt according to an embodiment of the present invention;

[0053] FIG. **7** is a top plan view, with upright frame elements removed, of an exercise device according to an embodiment of the present invention;

[0054] FIG. **8** is a rear elevational view of an exercise device according to an embodiment of the present invention;

[0055] FIG. **9** is a perspective view of an exercise device according to an embodiment of the present invention;

[0056] FIG. **10** is a flowchart depicting a procedure for speed control of an exercise device according to an embodiment of the present invention; and

[0057] FIGS. **11** and **12** are side and partial top views illustrating an exercise device according to an embodiment of the present invention.

[0058] FIG. **13** is a chart depicting the force exerted by a user's foot on a bicycle pedal over time.

[0059] FIG. **14** is a side elevational view, partially in cross-section, of a preferred embodiment of a bike machine constructed in accordance with the principles of the present invention with its transmission on the carriage.

[0060] FIG. **15** is a side elevational view, partially in cross-section, of a preferred embodiment of a bike machine constructed in accordance with the principles of the present invention with its transmission on the support.

[0061] FIG. **16** is a side elevational view, partially in cross-section, of an alternate preferred embodiment of a bike machine constructed in accordance with the principles of the present invention with its transmission on the support.

[0062] FIG. **17** is a side elevational view, partially in cross-section, of an alternate preferred embodiment of a bike machine constructed in accordance with the principles of the present invention with its motor and drive train in the carriage.

[0063] FIG. **18** is a side elevational view, partially in cross-section, of a preferred embodiment of a rowing machine constructed in accordance with the principles of the present invention.

[0064] FIG. **19** is a side elevational view of the one-way clutch mechanism of FIG. **18**.

[0065] FIG. **20** is a side elevational view, partially in cross-section, of an alternate preferred embodiment of a carriage path of a bike machine constructed in accordance with the principles of the present invention.

[0066] FIG. **21** is a front embodiment view of the variable dynamic friction element of FIGS. **15** and **16**.

[0067] FIG. **22** is a side elevational view of a weight dependent friction method for use with the preferred embodiments of FIGS. **14**, **15** and **17**.

[0068] FIG. **23** is a chart depicting the force vs. displacement for healthy triceps exertion.

[0069] FIG. **24** is a chart depicting the force vs. displacement for injured triceps exertion.

[0070] FIG. **25** is a chart depicting the force vs. displacement for weight bearing triceps exercise.
[0071] FIG. **26** is a chart depicting the force vs. displacement for spring bearing triceps exercise.
[0072] FIG. **27** is a chart depicting the force vs. displacement for flywheel/resistance triceps exercise.
[0073] FIG. **28** is perspective view of a strength exercise apparatus according to one embodiment of the present invention.
[0074] FIG. **29** is a perspective view of a strength exercise apparatus according to another embodiment of the present invention.
[0075] FIG. **30***a* is a side view of a means to provide oscillations according to the principles of the present invention.
[0076] FIG. **30***b* is a side view of an alternate means to provide oscillations according to the principles of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0077] As seen in FIG. **1**, according to one embodiment, an exercise device includes a lower frame member, **23** supported by front and rear frame supports **12**, **24**. The frame members, support members and the like can be made of a number of materials, including metal, such as steel or aluminum, plastic, fiberglass, wood, reinforced and/or composite materials, ceramics and the like. Preferably the frame supports **12**, **24** are coupled to the lower frame such that the lower frame can be inclined **142** at various angles. For example, the incline of the machine can be adjusted by providing front supports **12** with various adjustment mechanisms such as a rack-and-pinion adjustment, hole-and-pin adjustment, ratchet adjustment, and the like. The machine can be operated at an inclination **142** within any of a range of angles, such as between about 2 degrees and 45 degrees (or more) to the horizontal **143**. Preferably, in the embodiment of FIG. **1**, at least some upward inclination **142** is provided during use, e.g., sufficient to overcome internal friction of the device so as to position the user towards the rearmost position **136**, while the user is not exercising.

[0078] Coupled to the frame on the left side thereof are front and rear idler wheels **9**, **25**, supporting a simulated ski **22** bearing a ski-type foot support **21**, preferably having both toe and heel cups to permit the user to slide the simulated ski both in a forward direction and in a rearward direction against resistance, as described more fully below. The ski **22** can be made of a number of materials, including wood, fiberglass, metal, ceramic, resin, reinforced or composite materials. Preferably the ski **22** can be translated in a forward **112** or rear **114** direction while supported by idler wheels **9**, **25**. If desired, additional idler wheels can be provided and/or additional supports such as a low-friction support plate or rail, or a belt, cable, chain, or other device running between idler wheels **9**, **25** can be used.

[0079] In the depicted embodiment the ski **22** is coupled to a roller **116** such that translation of the ski **22** in a forward direction **112** rotates the roller **116** in a first direction **118**, and translation of the ski **22** in the opposite direction **114** rotates roller **116** in the opposite direction **122**. Coupling to achieve such driven rotation of the roller **116** can be achieved in a number of fashions. For example, the roller's exterior cylindrical surface **124** and the bottom surface **126** of the ski **22** may be provided with high friction coatings. Teeth may be provided on the surfaces of the ski **22** and the roller **116** to drive the roller in a rack-and-pinion-like fashion. Ski **22** may be coupled to a line wrapper about the roller **116**. Although in the view of FIG. **1**, only a single (left) set of idler rollers **9**, **25**, driven roller **116** and ski **22** are depicted, a substantially identical set (not shown in FIG. **1**) will be coupled on the opposite (right) side of the lower frame **23**, some of which are shown in FIG. **2**.

[0080] In the depicted embodiment, resistance to rearward movement **114** of the ski **22** is achieved by coupling the driven roller **116** so as to, in turn, drive a flywheel **17** which can be braked as described more fully below. As depicted in FIG. **2**, in one embodiment the driven rollers **116***a*, **116***b* are the exterior surfaces of one-way clutches **20***a*, **20***b* configured such that when a ski **22***a* is moved in a forward direction **114** so as to drive the exterior surface in a first rotational direction **122**, the corresponding one-way clutch **20***a* disengages so that the clutch overrides the driveshaft **31** and is essentially disengaged therefrom. The driveshaft **31** is rotationally mounted in driveshaft bearing **28** and shaft collars **32**. A number of one-way clutch devices can be used, including a spring clutch, a plate clutch or a cam clutch. In one embodiment, a clutch of the type used in a NordicTrack™ exercise device (for a different purpose) is used. As seen in FIG. **2**, each ski **22***a*, **22***b*, is coupled to the same type of one-way clutch **20***a*, **20***b*, for selectively driving the driveshaft **31**. Accordingly, the driveshaft **31** will be driven in a first rotational direction **122** whenever either the left ski **22***b* or the right ski **22***a* drives the left driven roller **116***a* or the driven roller **116***b* in the rearward rotational direction **122**.

[0081] In the depicted embodiment, the driveshaft **31** is coupled to a second shaft **35** via V-belt **18**, running around sheaves **19**, **16**. Second shaft **35** is directly coupled to the flywheel **17**. Thus, driving the driveshaft **31** results in rotation of the flywheel **17**.

[0082] Because the flywheel, by virtue of its mass and effective radius (diameter) requires a substantial amount of energy to rotate, the flywheel creates a certain amount of resistance to rotation of the driven rollers and thus, the translation of skis **22***a*, **22***b*. Looked at in another way, and without wishing to be bound by any theory, it is believed the flywheel **17** resists the energy generated by the user in moving the skis rearwardly, causing the user's body to thrust forward. In the depicted embodiment, the speed of rotation of the flywheel can be controlled using mechanisms described more thoroughly below.

[0083] Preferably, resistance is also provided to rotation of the driven roller **116***a*, **116***b* in the opposite (forward) direction **118**. Such resistance can be useful in more accurately simulating natural exercise, such as a resistance to forward-sliding of cross-country skis through snow. In the depicted embodiment, brake pads **29***a*, **29***b* are urged against the inner faces of the one-way clutches **20***a*, **20***b*, e.g., by brake springs **30***a*, **30***b*. Preferably the brake pad **29** is coupled to the driveshaft **31** so as to rotate therewith. Accordingly, when a ski **22** is moved in the rearward direction **114** and the corresponding one-way clutch **20***a* is engaged with driveshaft **31**, the brake pad **29***a* rotates with the inner face **132***a* of the one-way clutch **20***a* so that substantially no friction braking of the one-way clutch **20***a* or driven roller **116***a* occurs. However, when the ski **22***a* is moved in the forward direction **112** so that the driven roller **116***a* is rotated in the forward rotational direction **118** and the one-way clutch is disengaged, the roller **116***a* and brake pad **29** are rotating in opposite directions **118**, **122**

respectively so that friction braking of the driven roller **116***a* occurs, providing frictional resistance to forward motion of the ski **22***a*.

[0084] In the depicted embodiment, a screw adjustment **27** is provided for adjusting the amount of friction (i.e., the pressure) of the brake pads **29***a*, **29***b* against the inner faces **132***a*, **132***b* of the rollers **116***a*, **116***b*. In the depicted embodiment, threaded adjust screws **27** are secured through the lower frame members **23** such that they press against the bearings **28**. As the screws **27** are tightened, they force the bearings **28** to press against the clutches **20** which in turn press against the brake pads **29** and compress the springs **30** thereby increasing the intensity of the one-way friction.

[0085] Returning to FIG. **1**, vertical frame member **7** and upper frame member **3** are preferably provided, extending upward and angularly outward with respect to the lower frame member **23**. These frame members **7**, **3** position upper arm exercise pulley **2***a*, **2***b* at a desired height such that the hand grips **1***a*, **1***b* can be grasped by a user for resisted pulling (as described below) to define a line of resistance (from the pulleys **2***a*, **2***b* to the user's hands) at a natural and comfortable height. The pulley **2***a* may be positioned, e.g., approximately at the shoulder height of the user. In one embodiment, the height of the pulley **2***a* may be adjusted, e.g., by pivoting **144** the upper arm **3**. In the depicted embodiment, the hand grip **1***a*, **1***b* are coupled to arm exercise lines **4***a*, **4***b* running over the upper arm exercise pulleys **2***a*, **2***b*, a second arm exercise pulley **5**, a third arm exercise pulley **11**, such that the opposite ends of the lines engage arm exercise one-way clutch drums **15***a*, **15***b*. As shown in FIG. **2**, preferably each line **4***a*, **4***b* is wound, e.g., in helical fashion around the corresponding drum **15***a*, **15***b*. Preferably each drum **15***a*, **15***b* is provided with a recoil spring **15***c*, **15***d* such that when a user releases or relaxes the grip or tension on a line **4***a*, **4***b*, the drum **15***a*, **15***b* will rotate in a retract direction **212** to return the lines **4***a*, **4***b* to its coiled configuration: Each drum **15***a*, **15***b* is coupled to a second shaft **35** via a one-way clutch **214***a*, **214***b*. Preferably, the arm exercise one-way clutches **214***a*, **214***b* are substantially identical to the leg exercise one-way clutches **20***a*, **20***b*. The one-way clutch is configured so that when a line **4***a* is pulled by a user in a first direction **216**, the one-way clutch **214***a* engages with the second shaft to drive the second shaft **35** in first rotational direction **222**. When the line **4***a* moves in a second, retract direction **212** (under urging of return spring **15***c*), the one-way clutch **214***a* disengages from the shaft **35** and overruns the shaft. Thus, in the depicted embodiment, the lines **4***a*, **4***b* are coupled to the same resistance mechanism, namely the flywheel **17**, as are the skis. The action of the arms and legs independently contribute to the momentum of the flywheel.

[0086] Returning to FIG. **1**, a friction belt **14** is provided engaging at least a portion (such as about 75%) of the circumference of the flywheel **17**. Preferably one end of the friction belt **14** is coupled to a spring **13** while the other end is coupled, via line **134**, ranging over friction band pulley **10** and second friction band pulley **6**, to a speed controller clothing clip **8**. In one embodiment, an elastic line member such as an elastic "bungee" cord **26** couples the line **134** to the clip **8**.

[0087] When the clip **8** is coupled to the user, such as by clipping to the user's belt or other clothing, net movement of the user backward **114** on the exercise machine relative to the frame **23** will result in tightening the friction band **14** on the flywheel **17** (in an amount dependent, at least partly, on the spring constant of the spring **13** and/or the effective spring constant of the elastic cord **26**), thus slowing the rotation of the flywheel **17**. As described above, the flywheel **17** is driven by the movement of the skis **22** and/or hand grips **1***a*, **1***b* in a one-way fashion, i.e., such that, in the absence of braking, moving the skis and hand grips faster tends to rotate the flywheel faster.

[0088] When the user is in the rearmost position of the machine **136**, the friction band is at its tightest around the flywheel, preventing it entirely from spinning. As the user begins exercising and moves forward **112**, pressure is released from the friction band and the flywheel begins spinning. Once the user has reached the speed desired by the user (i.e., the level of effort desired by the user), the user continues to exercise at this level and the system will automatically substantially maintain the corresponding speed of the flywheel. If the user slows his or her pace, the user will begin to drift back on the machine **114**, under gravity power because of the machine incline **142**, resulting in the tightening of the friction band **14** and the slowing of the flywheel speed. As the user speeds up his or her pace, he or she will move forward on the machine **112**, decreasing the pressure on the fiction band and thereby increasing the flywheel speed. Thus the system provides a method for speed control operated simply by the exerciser increasing or decreasing his or her level of effort. Thus there is no requirement for manual adjustments in order to change the intensity of the workout.

[0089] In practice, the user will mount the device, insert his or her feet into the foot support **21** of the skis **22** and grasp the hand grips **1**. The user will attach the clothing clip **8** to his or her clothing. Initially the user will be near the rear-most position **136** and the friction band **14** will be at its tightest. The user will move the skis in reciprocating fashion with a normal skiing motion and, because of the resistance mechanisms described above, the user will begin to move up **112** the incline **142** toward the front of the machine **138** and will cause the flywheel to begin rotating. Once the flywheel begins to spin, as the user's position fore and aft on the machine changes, there will be resultant constant variations in the machine friction band tension on the flywheel. As the user slows, the momentum of the flywheel will tend to propel him or her backward. However, as the user moves back, the friction band is tightened, as described above, and thus the flywheel begins to slow down until a balance is attained. As the user speeds up, the friction band is eased, and the flywheel is allowed to accelerate. This system will thus automatically vary the machine speed based on the user's position without the need to make manual adjustments or input. The user can, however, adjust the machine in a number of ways to affect the intensity of the exercise, if desired. The user may turn the adjusting knobs **27** to increase or decrease the forward resistance (e.g., to simulate varying friction conditions of snow). The user may change the incline of the machine **142** to increase or decrease the intensity of the exercise. If desired, the user will also pull on the ropes or hand grips **1***a*, **1***b* in the desired fashion for upper body resistance exercise. The user may pull on the ropes in an alternating fashion, parallel fashion, using either arm alone or the user may refrain from pulling on the ropes at all. As the user expends a greater level of effort (the sum of leg backward effort and any rope-pulling), the machine will automatically adjust the amount of friction on the flywheel **17** owing to the user's movement up or down the incline of the machine, depending on the user's level of effort.

[0090] A somewhat different speed control configuration is depicted in FIG. **3**. In the embodiment of FIG. **3**, there is no need for the friction strap **14** to be coupled via a line to the user's clothing. Instead, the depicted friction control is based on the fact that if a user moves upward (i.e., up the incline **142**) toward the front of the machine **138**, the machine, although each driven roller **116***a*, **116***b* will be alternatively driven in forward **118** and reverse **122** directions, there will be greater amount of forward rotation **118** than rearward rotation **122** as the user moves up the incline.

[0091] In the embodiment of FIG. **3**, a line **37** is coupled between left and right rope spools **40***a*, **40***b* which rotate with the driven rollers **116***a*, **116***b*. Line **37** runs, in order, around a left fixed pulley **35***a*, a movable speed control pulley **38**, and a right fixed pulley **35***b*. The amount of line **37** which, at any one time, is not wound on the spools **40***a*, **40***b* (i.e. the amount between the spools **49***a*, **40***b* and running around pulleys **35***a*, **38**, **35***b*) will be referred to as the free line. If a user is maintaining his or her level of effort and thus staying at an average fixed location on the incline, as the user reciprocates the skis left and right, the rope **37** will move from one spool to the other, with no net movement of the movable pulley **38**. Furthermore, as the user moves the left ski **22***a* backward and the right ski **22***b* forward an equal amount, the line **37** will unspool from the left spool **40***a*, and spool a substantially equal amount onto the right spool **40***b*. When the user in the reciprocating motion moves the right ski **22***b* backward, the same amount of line **37** will spool off the right spool **40***b* and onto the left spool **40***a*. However, as the user expends a greater amount of energy, the user will move up the incline and thus on average, the forward strokes of the skis will be longer than the rearward strokes. This will result in the same amount of line **37** being unspoiled from the spools **40***a*, **40***b*, causing the effective free line length from the left spool **40***a* to right spool **40***b* (not considering the amount of line on the spools) to lengthen. As the effective length of the line lengthens, the movable pulley **38** is pulled forward **314**, under urging of spring **13** which relaxes somewhat causing the line **39** to pull less tightly on the friction band **14**, decreasing friction on the flywheel **17**. As a result, as the user moves upward up the incline, the friction band **14** will loosen. As the user moves down the incline toward the rearmost position **136**, the amount of free line will shorten, moving free pulley **38** rearwardly **312** and causing the friction band **14** to tighten.

[0092] FIG. **4** depicts another embodiment which uses a series of miter gears **44**, **45** formed in a fashion similar to an automobile differential gear. With the differential gears of an automobile, (including those found in some toy automobiles) considering a car with wheels off the ground, spinning a wheel in one direction with the driveshaft locked results in other wheel spinning in the opposite direction. Unlocking the driveshaft, as long as one wheel spins an amount equal and opposite to the other, the driveshaft remains unchanged. If both wheels spin a net amount in the same direction, the driveshaft will rotate.

[0093] In FIG. **4**, a first set of drive gears **47** are attached to the rollers **116***a*, **116***b*. These engage a second set of drive gears **43** which are connected to a set of first miter gears **44** and encircled by a friction band cord spool **46**. A friction band cord **39** wraps around the spool **46** and attaches to the friction band **14**. When one ski goes forward and the other goes back an equal amount, the opposite spinning first miter gears **44** counter each other in an equal and opposite manner. Since skiing is an alternating activity, the gearshaft **42** driven via gear trains **412***a*, **412***b* will remain relatively still while a user is skiing in one position on the machine, i.e. moving the skis substantially the same amount forward as backward. As a result the friction band cord spool **46** remains unchanged. If the user's average position moves fore or aft on the machine, the gearshaft **42** will turn in one direction or the other. Thus, as the user moves forward or backward on the machine, the gear shaft **42** will rotate forward or backward, via the differential or miter gears **44**, **45**, to rotate the friction band cord spool **46**, causing line **39** to loosen or tighten so as to loosen or tighten the friction band **14**. As will be clear to those of skill in the art, a number of differential gear devices can be used for this purpose.

[0094] FIG. **5** depicts an embodiment showing a number of alternative configurations. In the embodiment of FIG. **5**, the user's feet, rather than being used to drive a simulated ski, instead drive a footcar **50** forward and back. The footcar **50** has wheels **49** with one-way clutches such that the footcar **50** is free to move in the forward direction (i.e., the wheel clutches are disengaged). When a footcar **50** is moved in the rearward direction, the wheels frictionally engage the inside of the surface of the conveyer belt **52** (i.e., the wheels are locked as footcar **50** is moved in the rearward direction).

[0095] FIG. **5** also depicts another method for controlling speed by driving a flywheel shaft with a motor. Using this method negates the need to incline the machine, as the motor overcomes any internal friction. The speed of the motor can be set manually such as on a treadmill or the speed potentiometer can be tied to one of the speed controllers described above such that the machine speed is dependent on the user's position on the machine.

[0096] In the embodiment of FIG. **5**, during backward motion **514** of the footcar **50**, while the footcar wheels **49** are locked, the amount of resistance to the backward motion of a given footcar perceived by the user will depend principally on the amount of forward friction on the opposing footcar and the inclination **542** of the exerciser with respect to the horizontal **543**.

[0097] Without wishing to be bound by any theory, it is believed that when an exerciser is exercising on a device according to the present invention, and if there is no net or average fore-aft movement (i.e., the exerciser is substantially maintaining his or her fore-aft position) the amount of resistance to a backward leg thrust is equal to the amount of resistance to forward movement of the opposite leg. It is believed that when the device is inclined, the resistance to forward movement has a contribution both from the one-way friction brake described above and resistance to movement up the incline, against gravity. During use of the device, the speed of rearward leg movement (ignoring arm exercise, for the moment) will be regulated by the speed of rotation of the flywheel which will be moving at a substantially constant speed if the user is maintaining his or her fore-aft position on the machine. It is believed that the friction band, when it is applied as described to selectively slow the flywheel, is operating so as to balance the effect of gravity when the machine is inclined, in the sense that, if there were no friction band or other selective flywheel speed control, the user would tend to slide backward toward the rear most position on the machine when the machine is inclined. It is believed that, in situations where a user moves forward or aft on the machine, there is a temporary small difference between the forward resistance and the rearward resistance.

[0098] As noted above, during bilateral motion using the exercise device of FIG. **5**, the user will tend to oscillate somewhat forward and backward (even if the user is maintaining a constant average fore-aft position with respect to the exercise machine), as the user pushes back on each leg alternately. If the machine is inclined such that the track along which the footcars move is tilted upwards **542**, with each forward oscillation, the user is also lifting his or her center of gravity a certain amount. The amount that the user lifts his or her center of gravity on each stride will depend not only on the length of the stride but also on the amount of inclination **542**. According to one embodiment, the exercise machine can be adjusted to affect the perceived difficulty or level of activity by increasing or decreasing the inclination.

[0099] In the depicted embodiment, the forward feet **526** are coupled to the lower frame **523** by pivot arm **66**. The pivot arm **66** can be held in any of the variety of pivot locations by adjusting the extension of link arm **528**. Thus, if the user wishes to increase the inclination **542** to an inclination greater than that depicted in FIG. **5**, the user may disengage the far end (not shown) of link arm **528**, which may be engaged by a plurality of mechanisms including bar and hook, pin and hole, rack and pinion, latching, ratcheting or other holding mechanisms, and extend the link arm **528**, e.g., to the position depicted in FIG. **5**A to increase the inclination of the machine to a higher value **542'**, and resecure the far end of link arm **528** as depicted in FIG. **5**A. If desired, the apparatus at FIG. **5** can be adjusted so that the footcars **50** move along a track which is angled downward toward the front of the machine (to simulate declined skiing situations).

[0100] When the device of FIG. **5** is set at an inclination **542** up to about 10 degrees, it is anticipated that users will typically employ the arm ropes **75**. At inclinations greater than about 10 degrees, it is anticipated that users may prefer to use the rail system **77**, **79**. The rail system is believed to offer an upper body exercise similar to using a pair of banisters when climbing stairs.

[0101] As discussed above in connection with FIGS. **1** through **4**, a variety of mechanisms can be used to sense the position and/or movement of the user along the fore-aft axis of the machine and to control speed, in response. In the embodiment of FIG. **5**, similar devices can be used for sensing fore-aft position of the exerciser. In the embodiment of FIG. **5**, it is preferred to use the position of the user to control the speed with which the belt **52** moves, e.g., by controlling the speed of motor **53**. For example, the speed of the motor **53** may be controlled by a motor speed potentiometer whose setting is determined by an arm coupled to a line or cable. Thus, whereas in the embodiments of FIGS. **1** through **4**, pulling on a line **34**, **39** resulted in tightening a friction band **14**, in the embodiment of FIG. **5**, pulling on a similar line in response to the fore-aft position of the exerciser moves a potentiometer arm so as to change the motor speed **53**. Thus, as the user moves forward on the machine of FIG. **5**, the potentiometer is preferably moved so as to increase the speed of motor **53**, and when the user moves backward, towards the rear of the machine, the potentiometer is moved to a position so as to decrease the speed of the belt **52**. In the embodiment depicted in FIG. **5**, rather than sensing the position of the user via a clothing clip or differential motion sensor, a sonar transducer is mounted to the upright frame **67** preferably at a height approximately near the user's abdomen to measure his or her distance from the front of the machine. In one embodiment, a microcontroller is used to operate the motor speed based on inputs from the transducer, e.g., according to the scheme depicted in FIG. **10**, discussed more thoroughly below. A number of sonic transducers can be used for this purpose, including model part #617810 available from Polaroid.

[0102] As depicted in FIG. **6**, the footcar **50** has a generally inverted U-shape configured to fit over the top of a rectangular tube section **60**. The rectangular tube section **60** includes longitudinal slots **612***a*, **612***b* which accommodate the axles **63***a*, **63***b* of the footcar. The axles **63***a*, **63***b* extend through the footcar axle bearings **614***a*, **614***b*, **614***c*, **614***d* and through the slots **612***a*, **612***b* as the footcar **50** and the square tube **1470**, the axles **63***a*, **63***b* bear footcar wheels **49***a*, **49***b*, **49***c*, **49***d*. Each of the wheels **49***a*, **49***b*, **49***c*, **49***d* are configured with a one-way clutch, as described above, such that the wheels **49***a*, **49***b*, **49***c*, **49***d* roll freely in a first direction **616** but are locked against rotation in the opposite direction **618**, when footcar **50** is moving aft **514**. A conveyor belt **52** is positioned in the interior of the square tube **60** with the bottom surfaces of the footcar wheels **49***a*, **49***b*, **49***c*, **49***d* contacting the inner surface **14802** of the lower limb of the conveyor belt **52**. The rear end of the conveyor belt **52** is retained by conveyor belt idler **59** held by an idler retainer **58** and backer plate **57**. An adjustable screw **65** can adjust the fore-aft position of the idler retainer **58** to adjust the tension on the belt **52**. The fore end of the belt **52** passes around the conveyor belt drive roller **70** (FIG. **7**) which is mounted on a drive shaft **83**. Preferably the footcars **50** are configured to provide adjustable resistance when moving in the forward **512** direction (independently of the amount of perceived resistance in the reverse direction).

[0103] In the embodiment described above in connection with FIGS. **1** through **4**, it was described how it was possible to construct one-way forward leg resistance in connection with the one-way clutches **20***a*, **20***b*. In the embodiment of FIGS. **5** and **6**, it is also preferable to provide an amount of forward leg resistance and, if desired, a mechanism similar to that discussed above in connection with FIGS. **1** through **4** can be used. In the embodiment of FIG. **6**, friction pads **64***a*, **64***b*, **64***c*, **64***d* can be made to bear against the outside surfaces of the wheels **49***a*, **49***b*, **49***c*, **49***d*. In the depicted embodiment, the wheels **49***a*, **49***b*, **49***c*, **49***d* are free to move laterally **624** a certain amount. Thus, in one embodiment, when adjusting screw **61** is tightened this screw presses against the outside of the friction pad **64***b* which in turn presses against the outside surface of the wheel **49***b*. A brake spring **62** pressing against the opposite side of the clutch **49** is provided to give increasing pressure against the tightening of the adjust screw **61**, resulting in greater friction to the clutch in the free wheel direction **616**.

[0104] Another embodiment is depicted in FIGS. **11** and **12**. a pair of slidable footcars (of which only the left footcar **1102** is seen in the view of FIG. **11**) is mounted on parallel tracks (of which only the upper surface of the left track **1104** is seen in the view of FIG. **11**). Although the tracks can be configured to provide a constant separation, such as a separation of about 12 inches (about 30 cm), the apparatus can also be configured to provide adjustable separation, e.g. via a rack and pinion mounting (not shown). The tracks are long enough to accommodate the full stride of the user, normally about 30 inches to 50 inches (about 75 cm to 125 cm).

[0105] The cars **1102** are designed to slide or travel linearly up and down **1106** the tracks. In the depicted embodiment, the cars travel on the tracks **1104** supported by wheels **1108***a*, *b* which are configured to maintain low rolling resistance to the tracks while carrying the full weight of the user.

[0106] A cable or belt **1110** attaches to the back of each car **1102** and extends in a loop over rear pulley **1112** and front pulley with integral one-way locking mechanism **1114**, to attach to the front of the car **1102**. The integral one-way locking mechanism of the front pulley can be, for example, similar to that used for the one-way clutches **20** *a, b* of the embodiment of FIG. **1**. In the depicted embodiment, the front pulley **114** and a speed controlled flywheel **1116** or motor (not shown) are mounted on (or coupled to) a common drive axle **1118**. The flywheel may be mounted on the drive axle in a fashion similar to that described for mounting a flywheel on shaft **35** in the embodiment of FIG. **2**. Preferably, the cable or belt is designed to grip the front pulley **1114** such that there is little or no slippage between the cable **110** and the pulley **1114**, even under load. In one configuration, the belt **1110** is a geared belt of the type used for a timing belt (e.g. a nylon belt) with mating cogs being provided on the forward pulley **1114**.

[0107] As depicted in FIG. **12**, each forward pulley **1114** *a, b* is configured with a one-way friction mechanism **1124***a, b*. The one-way locking mechanism and one-way friction mechanism are configured such that when a car **1102** is moved in rearward direction, the locking mechanism **1124** engages and spins the drive axle **1118**, driving the flywheel **1116**. When a car **1102** is moved in the forward direction, the one-way locking mechanism **1124** releases and the one-way friction mechanism **1122** causes a rearward force on the car **1102** transferred from the momentum of the moving flywheel **1116** or motor force. The intensity of the one-way friction mechanism **1122** can be made adjustable (such as by adjusting the force of springs **1121** *a, b* and, thus, washers **1122** *a, b* on the friction pads **1124** *a, b*) or kept at a fixed level. The inclination of the tracks can be varied, as described for other embodiments herein. Arm exercise mechanisms can be coupled to the drive shaft as described for other embodiments herein.

[0108] FIGS. **7** through **9** also depict an arm exercise mechanism. In the depicted embodiment, an upright frame element **67** accommodates left and right ropes **812**, **814**. At first end of rope **812** is coupled to a left hand grip **75***a*. The rope **812** then is positioned over a first fixed pulley **816***a*, over a second movable pulley **818***a*, (coupled to arm line **68***a*) to a second fixed pulley **822***a* and thence coupled to a rail hand grip **77***a* configured to slide along rail **79***a*. As can be seen in FIG. **8**, a similar arrangement is provided for the right rope **814**. If the machine is declined **545**, it is anticipated that the user will typically use the hand grips **75***a*, **75***b* rather than the rail grips **77***a*, **77***b*.

[0109] The arm exercise lines **68***a*, **68***b* are wrapped around spools **72***a*, **72***b* coupled by one-way clutches **712***a*, **712***b* to the driveshaft **83**. A number of one-way clutches can be used for this purpose, including clutches similar to those **20***a*, **20***b* used in connection with the driven rollers **116***a*, **116***b*. The spools **72***a*, **72***b* are coupled by the clutches **712***a*, **712***b* to the driveshaft **83** in such a manner that unwinding either of the ropes **68***a*, **68***b* by pulling on the hand grips **75***a*, **75***b*, **77***a*, will cause the clutch to engage and lock against the shaft **83** in the same direction that the shaft is spinning the belt drive rollers **70**. A pair of recoil springs **71***a*, **71***b* retract the ropes **68***a*, **68***b* onto the spools **71***a*, **71***b* when the user relaxes tension on the ropes **68***a*, **68***b*.

[0110] By pulling on either end of the ropes **812**, **814**, i.e., by pulling on hand grips **75***a*, **75***b* or rail grips **77***a*, **77***b*, the movable pulleys **818***a*, **818***b* are, respectively, pulled upward, unspooling lines **68***a*, **68***b* from the spool **72***a*, **72***b* such that the user perceives the resistance to be pulling on the handle **75**, **77** (greater than internal or friction resistance) if the speed of pulling is such that the spools **72***a*, **72***b* are rotating at a rotational rate faster than that of the current rotational rate of the shaft **83**. The linear speed of the rope ends **75***a*, **75***b*, **77***a*, **77***b* is related to rotational rate of the spools **72***a*, **72***b*. In one embodiment, this can be done by pulling each rope **68***a*, **68***b* until it is completely unwound from the spools **72***a*, **72***b* and rewrapping it under manual guidance, on a different portion of the spools with a different diameter. The same effect could be achieved using a bicycle-type derailleur to automatically shift the ropes from one diameter section to another. Although in the depicted embodiment only two diameters of spool are shown, three or more could be provided if desired, or a single diameter could be provided. It is also possible to couple the spools **72***a*, **72***b* to the driveshaft **83** via a linkage such as a chain drive, belt drive, gear train or the like, which could be provided with changeable transmissions for changing the effective ratio and thus the relative resistance to arm exercise.

[0111] In use, the exerciser can choose to manually control the motor speed, e.g., via a manual potentiometer knob or other adjustment, or can rely on the speed controller described above for automatic adjustment. The user steps onto the footcars **50** and, beginning at the rearmost position, typically, starts an alternating "walking" type motion. Initially, the conveyor belts are stopped and thus the wheels with the one way clutches on the foot cars allow the cars to slide forward but not backward. As a result, the user moves towards the front of the machine. As the user moves forward, the speed control circuit, as described above, causes the motor **53** to begin driving the belts. As the user approaches the front of the machine, the user may, if desired, grasp the hand grips **75***a*, **75***b* or **77***a*, **77***b*, preferably continuing the walking motion. As the motor begins to move the conveyor belts, the user's position is changed relative to the frame of the exerciser and the speed control circuit, described above, continually adjusts the speed of the conveyor belts to the user's stride.

[0112] Preferably the rails **79** can be pivoted so that they can be folded out of the way as depicted in FIG. **5** or extended as in depicted in FIG. **5**A for use. To adjust the position of the rails **79** adjust knobs **82** (FIG. **9**) are loosened to allow rail support **80** to slide freely. When the rails **79** are positioned in the desired location, the knobs **82** are tightened to hold the rails in the desired position.

[0113] FIG. **10** depicts a procedure that can be used for adjusting the speed of motor **53**. In one embodiment the procedure depicted in FIG. **10** is implemented using a microcontroller for controlling the motor. In the embodiment of FIG. **10**, it is preferred that if the user is more than a predetermined distance aft (such as five feet or greater from the front of the machine) **1012**, the belts **522** will be immobile, i.e., the motor speed will be set to zero **1014**. Similarly, if at any time the distance of the user from the front of the machine changes at a rate of greater than one foot per second for greater than 1.5 feet **1016**, the belts are similarly stopped by setting the motor speed to zero **1018**. The procedure preferably differs somewhat depending on whether the machine is in start-up mode (e.g., after the user initially mounts the machine) or is in normal or run mode.

[0114] Preferably, the unit will not start unless the range (i.e., the distance of the user from the front of the machine) is less than a predetermined amount such as two feet **1022**. If the user is not in this range, the procedure loops **1024** until the user moves within range. Once the user has moved within range, the machine is initially in start-up mode and the speed is set to a predetermined initial speed such as 25% of maximum speed **1026**. In one embodiment, the controller will ramp up a speed gradually so that the output from the microcontroller board can go immediately to 25% upon start-up. Assuming the maximum velocity condition has not been exceeded **1016**, if the range stays below three feet **1028** within three seconds **1032** while the device is in start-up mode **1034** the speed will increase by 10% **1036** each second **1038**, looping **1042** through this start-up procedure **1044** until the user exceeds a range of three feet **1028**. Once the user exceeds a range of three feet from the front of the machine **1028**, i.e., is within the range of three feet to four feet **1046**, the motor speed **53** will be maintained **1048** and the machine will thereafter be considered to be in run mode **1052**.

[0115] In general, the speed of the machine will be maintained constant whenever the user is in a predetermined range such as three to four feet **1046**. Once the device is out of start-up mode, in general, the procedure will decrease motor speed if the position exceeds four feet or increase motor speed if the range falls below three feet, (until such time as the user exceeds a predetermined maximum range **1012** or a predetermined speed **1016**). In the depicted embodiment, if the range goes to 4.1 to 4.3 feet **1054** the speed will be decreased by five percent **1056** every second **1058** until the range is back to three to four feet **1046** at which point the present speed will be maintained **1048**. If the range goes to 4.4 to 4.6 feet **1062** the speed will be decreased by 10 percent **1064** every half second **1066** until the range is back to three to four feet **1046**. If the range goes to 4.7 to 4.9 feet **1068** the speed will be decreased by 20 percent **1072** every half second **1074** until the range is back to three to four feet. If the range exceeds five feet **1012**, the motor speed will be set to zero **1014** and the unit will not start again until the range is less than two feet **1022**. If the range goes to 2.9 to 2.7 feet **1076** the speed will be increased by five percent **1078** every second **1082** until the range is back to three to four feet. If the range goes to 2.6 feet or less **1084** the speed will be increased by 10 percent **1086** every half second **1088** until the range is back to three to four feet or full speed is attained, at which point present speed will be maintained. As will be clear to those of skill in the art, the number of categories of speed, the amount of increase in speed and the rate at which speed increments are added can all be varied. Additionally, it is possible to define motor speed as a continuous function of position, rather than as a discrete (stepwise) function. Other types of control can be used such as controls which automatically vary the speed at predetermined times, or in predetermined circumstances, e.g., to simulate different snow or terrain conditions, controls which automatically raise or lower the elevation **528**, **542** to simulate variations in terrain and the like.

[0116] In light of the above description a number of advantages of the present invention can be seen. The present invention more accurately simulates natural exercise than most previous devices. In one embodiment the device provides resistance to forward or upward leg movement rather than only rearward leg movement. Preferably forward leg movement resistance can be adjusted. Preferably the device controls the speed and/or resistance offered or perceived and, in one embodiment speed is controlled in response to the fore-aft location of the user on the machine. In one embodiment, the fore-aft location is detected automatically and may, in some embodiments, be detected without physically connecting the user to the machine, e.g., by a clothing clip or otherwise. The device is capable of providing upper body exercise, preferably such that, as a user maintains a given level of overall effort, expenditure of greater lower body efforts permits expenditure of less upper body effort and vice versa. Preferably the arm exercise is bilaterally independent such that user may exercise left and right arms alternately, in parallel, or may exercise only one or neither arm during leg exercise.

[0117] A number of variations and modifications of the present invention can be used. In general, the described method of speed control (preferably involving automatically adjusting speed or perceived resistance based on fore-aft position of the user, without the need for manual input or control) is applicable to exercise machines other than ski simulation machines, including treadmill or other running or walking machines, stair climbing simulators, bicycling simulators, rowing machines, climbing simulators, and the like.

[0118] Although FIG. **1** depicts a device inclined upward in the forward direction, it would be possible to provide a machine which could be inclined downward in the forward direction if desired, although this would remove the gravity-power aspect of the configuration.

[0119] Although embodiments are described in which speed control is provided by a braked flywheel, other speed control devices can also be used. The flywheel could be braked by a drum-type brake or a pressure plate- or pad-type brake in addition to the circumferential pressure belt brake. The drive roller **116** could be coupled to drive an electric generator for generating energy, e.g., to be dissipated with variable resistance. The flywheel **17** can be provided with fins, blades, or otherwise configured to be resisted by air resistance.

[0120] Although in FIG. **2**, two shafts are depicted **31**, **35**, coupled by a belt **18**, it would be possible to have the clutches **20***a*, **20***b* coupled directly to the flywheel shaft **31**, or otherwise to provide only a single shaft. Although it is preferred to use the same resistance mechanism (e.g. flywheel **17**) from arm and (backward) leg motion, it would be possible to provide separate resistance devices (such as two flywheels).

[0121] Although the embodiment of FIG. **5** depicts two separate treadmills, one for each footcar, it is possible to provide a configuration in which a single treadmill is provided extending across the width of the device. In situations where two treadmills are provided, it would be possible to configure the device such that the treadmills can move at different speeds (such as by driving each with a separate motor or providing reduction gearing for one or both treadmills), e.g., for rehabilitative exercise and the like.

[0122] In one embodiment, the inclination **542** can be changed automatically, e.g., by extending link arm **528** using a motor to drive a rack and pinion connection. Preferably, the motor is activated in response to manual user input or in response to a pre-programmed or pre-stored exercise routine such that the device can be elevated during exercise.

[0123] Although in the embodiment of FIG. **5** the speed of the belt movement was adjusted by adjusting the speed of the motor **53**, it would also be possible to use a constant-speed motor **53** and employ, e.g., shiftable gears to change the belt speed. It is also possible to provide speed control which is configured to provide a constant speed rather than a variable or adjustable speed.

[0124] Although it is recognized that there may be some amount of resistance to forward (or upward) leg movement arising from internal machine resistance and/or overcoming the effects of gravity, preferably the exercise device of the present invention can provide forward or upward leg movement resistance which is greater than internal machine resistance and/or gravity resistance and preferably is adjustable (which internal machine resistance and gravity resistance typically are not).

[0125] Although it is anticipated that users will typically perform leg exercise in an alternating, reciprocal fashion, preferably the exercise device does not force the user into this type of exercise. In the depicted embodiments, there is nothing in the machine that would prevent a user from moving one leg more vigorously than the other (or even keeping one leg stationary) although it might be necessary to adjust speed control to accommodate this type of movement.

[0126] Perhaps the most important advantage of the present invention is its ability to replicate the forces found in nature. This advantage is illustrated in its simplest form by the graphical representation of FIG. **13**. For most activities involving muscle exertion, a person increases the amount of force applied during the course of a movement. For example, when a person throws a ball, the force he exerts on the ball is greatest just before his release. The same is true for running, biking, rowing, etc.

[0127] Generally, the present invention consists of a user mountable carriage designed to slide in the fore and aft direction. The carriage contains a power transfer element, such as pedals, arm levers or the like, which convert the user's motions into a means for propelling the carriage relative to a dynamic element. A dynamic element generally consists of an endless belt or the like driven by a motor or by a slight incline to a base frame. Additionally, a rearward friction or force element causes a rearward force against the carriage preferably relative to the dynamic element. This rearward force to the carriage can simulate the drag and other resistance encountered in nature.

[0128] As a user operates the motion machine designed according to the principles of the present invention he generates a cyclic motion of the user carriage caused by the reciprocating action of his arms and/or legs. As a result, the carriage will be in a constant state of acceleration and deceleration within its framework. For discussion purposes, this cyclic motion includes and will be defined as the power stroke, (such as when a user begins pushing on a pedal) and a rest stroke (such as when a user reaches the bottom of his pedal stroke). During the power stroke the user sends power through the power transfer element on the carriage to the dynamic element. During the rest stroke, the carriage is pushed by the dynamic or other force element.

[0129] A speed controller, such as a potentiometer on the motorized version of this embodiment, controls the speed of the machine. Alternatively, an automatic speed control can be used which ascertains the fore/aft position of the carriage within the support frame and sets the motor speed accordingly. More specifically, when the carriage is positioned on the middle of the frame, the speed controller maintains the current motor speed. If the carriage begins to move rearward due to the user slowing down, the speed controller slows the motor speed to encourage the carriage to become centered again. Similarly, if the carriage begins to move forward due to the user speeding up, the speed controller increases the motor speed to once again encourage the carriage to become centered. This feature allows the user to exercise at whatever pace he desires, including the ability to speed up or slow down without making any adjustments to the machine.

[0130] For illustration purposes, the principles of the present invention have been and will continue to be shown and described as they relate to particular preferred embodiments of exercise apparatus and the like. However, it will be understood that these principles are in no way deemed to be limited to such described embodiments. In fact, it will be further understood that these principles will apply to any form of human propelled motion machines.

[0131] Referring now back to FIG. **13**, the force between a user's foot and a pedal on both a stationary exercise bike (dashed lines) **1200** and a non-stationary bike (solid lines) **1210** while in use are shown. Note that Force is represented on the y-axis and time (with T=one full pedal revolution) is represented on the x-axis. With respect to the non-stationary bike (i.e. a real bike or a bike incorporating the present invention) **1210**, as the user begins his stroke, the bike accelerates forward in a manner such that the force on the pedal increases as the stroke progresses. On the other hand and with respect to the stationary bike **1200**, as the user begins his stroke, he encounters the rotating flywheel. However, because of the stationary nature of the machine his full force is translated directly to the flywheel. As the flywheel will resist any change in angular momentum, the force on the user's foot will be high and constant from the beginning to the end of the stroke.

[0132] Therefore, the graph of FIG. **13** demonstrates that for a given perceived force output, the user of a non-stationary bike will exert a greater net force while experiencing less stress to the joints and muscles of the leg as compared to the user of a stationary bike. Thus, the forces with respect to the non-stationary bike are healthier for the body's joints and muscles. This becomes particularly important when the present invention is incorporated within applications involving physical therapy where it is crucial to reduce the impact of force on recuperating bodies.

[0133] FIG. **14** illustrates one of the preferred embodiments of the present invention. This bike machine **1220** embodiment can be broken down into two main assemblies, the user carriage assembly **1230** and the support assembly **1240**. The user carriage consists of a frame **1250** upon which is mounted a slide bearing **1260**, a pair of idlers **1270**, a drive element tensioner **1280** which adjusts rearward force on the carriage, and the typical bicycle components including a handle bar **1290**, seat **1300**, crank set **1310**, derailleur **1320**, drive wheel **1340** and gear shift **1350**. The support **1240** consists of a frame **1360**, a pair of stops **1370**, a slide bearing rail **1380**, a drive element **1390**, drive element idler **1400**, drive element drive wheel **1410**, motor **1420** and an incline mechanism **1430** to provide for an adjustable positioning of the support **1240** and carriage assembly **1230** above a support surface **1440**.

[0134] The carriage assembly **1230** is slidably mounted on the support assembly **1240** via slide bearing **1260** over bearing rail **1380**. It is preferred that such a bearing combination be chosen such that with a user's full body weight on the carriage **1230**, the carriage **1230** fore and aft friction is minimal. Although there are many types of bearing systems that will allow the carriage to freely move in the fore and aft directions, the preferred embodiment depicts a slide rail design. Other designs may include ball bearings, roller bearings, Teflon™ bearings, magnetic levitation, fluid bearings, etc. Additional features of the bearing system might include a certain amount of flexibility so that as the user exerts force to motivate the carriage, a certain amount of "give" is present to absorb some of the shock. Also, the design may allow for side to side or up and down motion in order to better simulate, for example, the side-to-side motion encountered when riding a bicycle or the up and down sensation of hitting a bump. This may include the ability to steer the carriage **1230** left and right within the confines of the support assembly **1240**.

[0135] Stops **1370** are placed on the front and back of the slide bearing rail **1380** to keep the carriage assembly **1230** within the usable fore/aft range of the bike machine **1220**. Preferably, these stops **1370** will incorporate spring means to avoid abrupt stopping when the user reaches the front or back of the machine. The stops **1370** can be spaced apart such that the carriage moves as little as a few inches between stops. However, the greater the distance, the more pleasurable the exercise experience will be to the user as a greater distance will allow for the ability to coast and rest between pedal strokes without being driven to the back of the machine

[0136] The carriage assembly **1230** has a drive train consisting of a standard bicycle crankset **1310** which drives the drive wheel **1340** and is preferably capable of using various gear ratios through the use of derailleur **1320**. In order to properly simulate real bicycle riding it is important that the angular momentum of the drive wheel **1340** be equivalent to the angular momentum carried by a normal bicycle which would be equivalent to the sum of the angular momentum of the front wheel and the back wheel. Additionally, it is also important that the weight of the carriage **1230** be approximately the same as that of a normal bicycle.

[0137] Motor **1420** drives drive element **1390** which engages drive wheel **1340** and is aligned by idlers **1270**. This drive element can be a rubber belt, a bicycle chain, a cable, etc. To properly simulate real bike riding, the motor should be able to convey the drive element from 0 to approximately 40 mph. In order to maintain a uniform speed during exercise, the motor should be chosen such that it is powerful enough to compensate for the constant cyclic action of the carriage. This can also be accomplished by giving a large amount of momentum to the drive elements by, for example, adding a flywheel to the motor.

[0138] Idlers **1270** hold the drive element **1390** against the drive wheel **1340**. The friction between the drive element **1390** and the drive wheel **1340** is crucial in simulating the feel of a real bicycle riding. To properly calibrate this friction, the pressure of the idlers **1270** is set so that the rearward force applied to the carriage by the drive element at a given speed is equivalent to the rearward force applied to a real bicycle and idler at the same speed as the result of wind resistance and friction between the road and the tires. Alternatively, a fixed rearward (or forward when operated in reverse) force can be applied to the carriage such as with a spring or a hanging weight.

[0139] In operation, the user mounts the carriage assembly **1230** and turns on the motor **1420** to the desired speed and direction (as the present invention allows user propulsion of the carriage in either forward or backward direction). If the user does not pedal, the carriage assembly **1230** will be propelled to the back of the rail **1380** against the back stop **1370**. As the user begins to pedal and the drive wheel **1340** reaches and exceeds the speed of the drive element, the carriage and user will begin to move forward. The goal of the user is to keep the carriage centered on the support assembly **1240**.

[0140] By increasing or decreasing the motor **1420** speed, the user can vary the intensity of his workout. The user can also vary the pressure on the drive wheel tensioner **1280** to vary the intensity of his workout. By reducing resistance, the machine will exhibit the same characteristics as a racing bike with thin, slick, high-pressure-tires. On the other hand, increasing the resistance will make the machine exhibit the characteristics of a mountain bike with wide, knobby, low-pressure tires.

[0141] Preferably, the user can simulate hill riding (both up and down) with the use of incline/decline mechanism **1430**. This mechanism tilts the entire machine **1220** with respect to the support surface **1440** and creates an incline/decline plane against which to exercise. Additionally, by including the derailleur **1320**, the user can change gear ratios between the crankset **1310** and drive wheel **1340**. This allows the user to maintain a steady cadence (pedal strokes per minute) over varying motor speeds and hill incline/decline.

[0142] FIG. **15** illustrates another preferred embodiment of the present invention. Once again, this bike machine **1450** embodiment can be broken down into two main assemblies, the user carriage assembly **1460** and the support assembly **1470**. The user carriage **1460** consists of a frame **1480** upon which is mounted a slide bearing **1490** and the typical bicycle components including a handlebar **1500**, seat **1510**, crank set **1520** and gear shifter **1530**. The support assembly **1470** consists of a rigid frame **1540**, a pair of stops **1560**, a slide bearing rail **1570**, a drive element **1580**, drive element idler **1590**, drive element drive wheel **1600**, tensioner idler **1610**, derailleur **1620**, multigear sprocket **1630**, tensioning springs **1640**, transfer drive element **1650**, motor drive element **1660**, motor **1670**, incline/decline mechanism **1680**, friction element **1690**, friction element idlers **1700** and friction element tether **1710**.

[0143] The carriage assembly **1460** is slidably mounted to the frame assembly **1470** via slide bearing rail **1570**. As previously discussed, the bearing combination is preferably chosen such that with the user's full body weight on the carriage **1460**, the carriage fore and aft friction is minimal. This fore and aft motion is kept between a controlled range as defined by stops **1560**. These stops would preferably incorporate spring means or the like to avoid abrupt stopping when the user carriage reaches the front or back of the machine **1450**.

[0144] The crank set **1520** drives drive element **1580** which is preferably a bicycle chain, belt, cable, etc. Drive element **1580** passes over idler **1590**, around tensioner idler **1610** and over drive element drive wheel **1600**. Tensioning spring **1640** allows the carriage assembly **1460** to move freely fore and aft while maintaining constant tension on the drive element **1580**. The larger diameter of the drive element drive wheel **1600** drives transfer element **1650** which is also preferably a bicycle chain, belt, cable, etc. This element **1650** passes through derailleur **1620** and around multigear sprocket **1630** (which is the equivalent to a multigear sprocket found on the rear wheel of a typical multi-speed bicycle). Parallel and directly attached to the multigear sprocket is a pulley which is driven by a motor **1670** and motor drive element **1660**.

[0145] Additionally, friction element **1690** (also shown in FIG. **21**) is also attached to the motor **1670**. This device is a cylindrical spindle which free-wheels on the motor shaft with a certain amount of preferably adjustable friction. A friction element tether **1710** is wrapped around the friction element **1690** and runs through friction element idlers **1700** to attach to the back of the carriage frame **1480**.

[0146] During operation, a user mounts the carriage **1460** and turns the motor **1670** on. As the motor spins, friction element **1690** applies a force to the friction element tether **1710** which pulls the carriage **1460** towards the back of the frame **1470**. This friction increases with faster motor speed thereby urging the carriage backwards with greater force. As the user begins to pedal at a rate slightly faster than the rotation of drive element drive wheel **1600**, the carriage **1460** will begin to move forward on the frame **1480**. By operating gear shifter **1530**, the user can vary the gear ratios on multi gear sprocket **1630**, thereby simulating the various gear ratios on a multi-speed bicycle. In order to simulate hill riding, the incline/decline mechanism **1680** is adjusted accordingly.

[0147] The bike machine **1720** of FIG. **16** is much like the bike machine of FIG. **15**, both of which have the transmission elements on the frame assembly. While many of the components of the bike machines of FIGS. **15** and **16** remain the same, their interconnecting has slightly changed. The bike machine **1720** of FIG. **15** includes the user carriage assembly **1730** and the support assembly **1740**. The user carriage **1730** consists of a frame **1750** upon which is mounted a slide bearing **1760** and the typical bicycle components including a handlebar **1770**, seat **1780**, crank set **1790** and gear shifter **1800**. The support assembly **1740** consists of a rigid frame **1810**, a pair of stops **1820** (including springs **1830**), a slide bearing rail **1840**, a drive element **1850**, drive element idlers **1860**, derailleur **1870**, multigear sprocket **1880**, transfer drive element **1890**, motor drive element **1900**, motor **1910**, incline/decline mechanism **1920**, friction element **1930**, friction element idlers **1940** and friction element tether **1950**.

[0148] Yet another preferred embodiment of a bike machine incorporating the principles of the present invention is illustrated in FIG. **17**. This bike machine **1960** has the same main components of a user carriage assembly **1970** and a support assembly **1980**. The carriage **1970** consists of a frame **1990** upon which is mounted a slide bearing **2000**, handlebar **2010**, seat **2020**, crank set **2030**, derailleur **2040**, crank set drive element **2050**, sprocket set **2060** and differential gear set **2070**. The differential gear set **2070** includes the carriage input **2080**, motor input **2090**, differential output **2100**, motor **2110**, differential drive element **2120** and variable friction device **2130**. The support assembly **1980** consists of a rigid frame **2140**, a pair of stops **2150**, slide bearing rail **2160** and an incline/decline mechanism **2170**.

[0149] The crank set **2030** drives the multigear sprocket **2060** thereby driving crank set drive element **2050** which is coupled to carriage input **2080** through variable friction device **2130**. The motor **2110**, preferably including a flywheel or the like, drives the motor input **2090**. Differential output **2100** is a spindle with differential drive element **2120** wrapped around it and fastened to the front and back of the frame **2140**.

[0150] It is preferable to incorporate an adjustable friction device **2130** at a point between crank set drive element **2050** and differential input **2080**. Adding a resistance at this point will cause the machine to exhibit the same characteristics as riding a bicycle on the road as this friction will simulate the forces of road and wind friction.

[0151] During operation, the user mounts the carriage **1970** and turns the motor speed to the desired setting. As the motor begins to rotate input **2090**, differential output **2100** will begin to turn thereby sliding the carriage assembly **1970** toward the rear of the machine. As the user begins to pedal, carriage input **2080** begins to rotate. As the user reaches a pedaling cadence such that element **2080** and element **2090** are rotating at equal rates, the carriage assembly will remain in a relatively steady fore and aft position. If the user momentarily stops pedaling, the drive element **2050** will begin to slow causing differential output **2100** to rotate and drive the carriage assembly **1970** backwards. On the other hand, if the user speeds up his pace such that the input **2080** rotates faster than input **2090**, differential output **2100** will drive the carriage assembly **1970** forward. Obviously, and as discussed with respect to FIG. **13**, as the user exerts effort on each stroke, the carriage assembly **1970** will oscillate fore and aft.

[0152] A variation of this embodiment can be operated without the use of a base frame. This can be done by replacing rail bearing **2000** and support assembly **1980** with wheels which allow the carriage to roll on a flat floor surface and driving the wheels with differential output **2100**. During operation, the user would mount the machine, turn on the motor and pedal. If the user's speed is equal to that of the motor speed, the machine will stay in a relatively stationary location. If the user accelerates or decelerates, the machine will move forward or backward. Additionally, placing the machine on an incline or decline plane, hill riding can be simulated.

[0153] Although the bike machine embodiments of FIGS. **14-17** included incline/decline mechanisms to simulate hill riding, the slight elevation of those machines would enable further embodiments that would not need to be motorized. In other words, the dynamic member would be propelled by slightly elevating the front end of the machine and allowing the carriage to ride on an inclined plane. Referring back to FIG. **14**, all of the components of this non-motorized embodiment would be the same as earlier described with the exception of motor **1420**. The non-motorized version would instead include a flywheel with a braking means such as a friction band or a generator with a variable load.

[0154] During use, the front of the machine is slightly elevated and as the user begins to pedal, the carriage is propelled forward and slightly up due to the incline. Because of this incline, the tendency of the carriage will be to return towards the rear of the frame. If the user continues to pedal, the dynamic element **1390** will be traversing the drive wheel **1340**, thereby rotating the flywheel (previously motor **1420**). The rate of rotation of the flywheel can then be further controlled by various speed control methods.

[0155] The human propelled differential motion machine of the present invention may also be utilized to simulate rowing. The preferred embodiment of such a rowing machine **2180** consists of a carriage assembly **2190** and a base support assembly **2200** and is illustrated in FIG. **18**. The carriage assembly **2190** consists of a frame **2210**, a seat **2220** and rollers **2230**, which allow the seat **2220** to freely slide fore and aft on the frame **2210**. The carriage further includes pull handle **2240** (attached to drive chain **2250**), foot support **2260**, drive wheel **2270**, one way drive clutch **2280**, recoil spring **2290**, friction device **2300** and carriage wheels **2310**. The base support consists of a frame **2320**, motor **2330**, drive element drive **2340**, drive element **2350**, idler **2360**, stops **2370** and incline/decline mechanism **2380**.

[0156] To operate, the user sets the motor speed to the desired level. The motor **2330** then drives element **2350** which engages drive wheel **2270** and friction device **2300**

causing the carriage assembly **2190** to move toward the back of the machine **2180**. The user then sits on the seat **2220** and secures his feet into the foot supports **2260**. While bending his knees, the user grasps pull handle **2240** and begins a rowing motion which involves straightening his knees and pulling with his arms. As the user pulls on the handle, drive chain **2250** engages one way clutch **2280** and rotates drive wheel **2270**. When the user reaches the end of his stroke, he bends his knees again and allows the recoil spring **2290** to retract the drive chain over the one way clutch in the freewheel direction. When the drive wheel **2270** exceeds the speed of drive element **2350**, the carriage assembly **2210** begins to move towards the front of the machine **2180**.

[0157] FIG. **19** is illustrative of an enlarged view of the one way clutch mechanism **2280** of FIG. **18**. The drive chain engages the mechanism about its outer circumference **2390** and upon the power stroke rotates counterclockwise **2400**. If this counterclockwise rotation is greater than the drive wheel **2270** rotation, the clutch engages the drive wheel and urges the carriage assembly **2190** forward. If this counterclockwise rotation is not greater than the drive wheel **2270** rotation or the clutch **2330** is rotating clockwise **2410** as during the rest stroke, it will be disengaged from the drive wheel **2270** and the carriage assembly **2190** is urged backwards due to the deceleration of the drive wheel **2270** relative to the drive element **2350**.

[0158] The user's goal with this rowing machine **2180** is again to maintain an average position between the stops **2370**. As he exercises, the carriage will travel forward during the power portion of his stroke and rearward during the rest portion. Additional to the upstream/downstream effect the incline/decline mechanism **2380** can offer, a multispeed derailleur mechanism may be added to the drive wheel **2270**. This would allow the user to increase or decrease the amount of effort required for exercise. It may also be beneficial to make friction mechanism **2300** adjustable. This would give the user a different means for increasing or decreasing the effort required for exercise. By increasing resistance, the experience would be similar to rowing a heavy wooden rowboat. By decreasing the resistance, the experience would be similar to rowing a light weight crew shell. By further reducing the resistance and increasing the gear ratio of the drive system, this machine can allow the user to exercise at a much greater speed than otherwise possible.

[0159] The present invention has thus far been described as it relates to a preferred skier embodiment, a preferred bicycle embodiment as well as a preferred rower embodiment. Other human motion simulating machines may be easily designed according to the principles described herein and as such would realistically exhibit the sensation of natural motion. However, rather than describing infinitive machines, the more general design characteristics that may be incorporated within any embodiment will now be discussed.

[0160] For example, an important design characteristic of the carriage is the consideration of the momentum exhibited thereby. When using the invention for bicycle riding, for example, in order to properly simulate the ride, the carriage should weigh approximately the same as a standard bicycle so that as it oscillates fore and aft, it will exhibit the same characteristics of a real bicycle. Additionally, the angular momentum carried by the rotating components of the carriage should be equivalent to those on a real bicycle, namely the angular momentum of the bicycle wheels.

[0161] A carriage used for simulating bicycle riding will generally use two pedals to drive the system and as such would be considered to be a two way dependant motion system which means that as one pedal is pushed down, the other necessarily comes up, i.e., the motion of one pedal is dependant upon the other. Other human propelled activities may use four way independent motion to propel the user, such as for example, cross-country skiing. In such a situation, the user can propel himself with one limb, or any combination of limbs without depending on the others. In order to properly simulate these, as well as other motions, the carriage can be designed to allow for dependent and/or independent motion.

[0162] In order to simulate, for example, bicycle riding, it is important that the carriage is allowed to travel a somewhat linear path. Referring now to FIG. **20**, since the goal of the user is to maintain the position of the carriage **2590** in roughly the middle **2600** of the machine **2610**, it may be desirable to use a non-linear path for the carriage slide system such that the front **2620** and rear **2630** of the path are slightly higher than the middle **2640**. This way, as the carriage is moved off center, it is encouraged to return to the lowest point on the path, i.e., the middle. This would allow the invention to be built on a shorter frame since the total fore and aft travel will be reduced.

[0163] Alternatively, it may be desirable to build a long track for the carriage. Such a design would be particularly beneficial when using multiple machines, side by side, for competition. It may also be beneficial to incorporate a long track with an inclined or declined portion so that, for example, when a user wishes to simulate riding uphill, he moves the carriage to the inclined section of the track.

[0164] Another important design characteristic is the amount of rearward force applied to carriage, or forward force when the invention is being used in reverse. On a bicycle, for example, this force is the equivalent to the rearward force applied to a moving bicycle due to wind resistance as well as the resistance between the bicycle tires and the road. The characteristics of this force may vary based on the resistance of the tires on the road, the speed of the bicycle over the road, air resistance, the rider's weight and the momentum of his legs during his pedal strokes. If the user applies a force equal and opposite in direction to this resistive or rearward force, the bicycle will travel at a constant velocity.

[0165] One method of providing rearward force is shown in FIG. **14**. As dynamic member **1390** passes over idlers **1270** and drive wheel **1340**, there is a certain amount of friction between these elements resulting in the tendency of the dynamic member **1390** to motivate the carriage assembly **1230** in a rearward direction. Idlers **1270** may be adjustable such that they apply greater or lesser pressure against the dynamic member **1390**. Another method for providing rearward force is to apply a braking pressure against one of idlers **1270** as demonstrated by the footcar of FIG. **6**.

[0166] Another method used in the present invention is demonstrated in FIG. **21**. This shows a variable dynamic friction element **2650** which can be added to the motor, or the moving device in the non-motorized version. It consists of a motor **2660**, or other moving device in the case of a non-motorized version, drive shaft **2670**, fixed coupling **2680**, friction pads **2690**, spindle **2700**, spring **2710** and a threaded knob adjuster **2720**, which mates with motor or moving device shaft threads **2730**.

[0167] In order to accurately exhibit the force characteristics found in nature, the diameter of the spindle **2700** must be chosen so that if it were allowed to spin at the same rate as the motor shaft, its surface speed would be equivalent to the speed the machine is simulating. In operation, a tether is wrapped around spindle **2700** and attached to the rear of the carriage assembly such that as the spindle turns in the direction of the motor shaft, the tether applies a force to the carriage in a rearward direction. As the motor rotates faster, the spindle **2700** applies increasing rearward force to the carriage. By adjusting knob **2720**, the user can create more or less resistance allowing the machine to have the feel of, for example, a mountain bike with low-pressure tires (high resistance) or a racing bike with high-pressure tires (low resistance).

[0168] FIG. **22** shows another rearward force method which is variable upon the user (and carriage) weight. It consists of a drive wheel **2740**, drive element **2760**, idler wheel **2770**, roller bearing **2780** and roller bearing rail **2790**. This method basically involves the replacement of bearing **1260** and rail **1380** of FIG. **14** with rolling bearing **2780** and roller rail **2790**, and replacing idlers **1270** from FIG. **14** with idler wheel **2770**.

[0169] As the user mounts the carriage **1230**, his weight (along with the weight of the carriage) forces drive wheel **2740** down against drive element **2760** and against idler **2770**. The carriage **1230** is capable of rolling fore and aft on roller bearing **2780** and rail **2790**. Drive wheel **2740** and idler **2770** are not fixed in location relative to one another, in other words, as the user mounts the carriage **1230**, his weight causes wheel **2740** to compress drive element **2760** onto idler **2770**. As a result, the greater the weight, the greater the force applied to the carriage.

[0170] Another method for applying rearward force involves using a generator mounted on the carriage designed to engage the dynamic element. For example, if friction element **1270** were replaced with a generator, a fixed or variable load can be placed across the generator to offer greater or lesser force against the dynamic element thereby driving the carriage in the direction of the dynamic element.

[0171] Another method for applying rearward force involves using a servo motor and a microprocessor or other control method. The servo motor is attached to the rear of the frame with a tether wrapped around its output shaft and attached to the carriage. The microprocessor directs the servo motor to apply a specified amount of force to the carriage. In this embodiment, it may be desirable to have the user enter his weight so that the microprocessor can accurately calculate the amount of force required.

[0172] It may be desirable to incorporate a strain gauge between the carriage and the rearward force device. This would allow for calibration of the invention and would also ensure that similar devices used for competition purposes would be equally matched.

[0173] It may also be desirable to simulate the forces caused by wind. For example, as a bicycle rider increases his speed, the apparent wind speed increases, thereby increasing the amount of rearward force on the bike. One way to simulate this effect is to incorporate a variable speed fan at the front of the machine. Another way is to calculate the force effects of wind and incorporate them into the force devices described above.

[0174] Another design characteristic involves the control of the speed of the dynamic element of the present invention. When using a motor to drive the dynamic element, a simple potentiometer can be used to adjust and control motor speed.

[0175] However, another method involves the use of an "intelligent" speed control system. This involves detecting the fore/aft position of the carriage and adjusting the speed of the dynamic element accordingly. The goal is to have the system speed up the dynamic member as the carriage approaches the front of the base, and slow down and eventually stop the dynamic member as the carriage approaches the back of the base. This way the user can "zone out" and not pay attention to his position on the machine. If he wishes to go faster, he simply speeds up his motions and the machine speeds up to match his pace. Conversely, as the user slows down, the machine slows down. If the user stops, the machine will stop before the carriage reaches the back of the base. This feature has tremendous value for allowing multiple users to compete with one another. The user can constantly change his pace without having to manually interface with the machine.

[0176] The goal of the speed control system is to keep the user roughly centered (fore and aft) on the machine. There may be times, however, when it is desirable to bring the user off center. For example, if it is desirable for the user to accelerate, it is best if he begins his acceleration from the back of the machine. As he accelerates, his position will move forward, and until he reaches the front stop, the invention will exhibit the exact characteristics of acceleration.

[0177] Detecting the fore/aft position of the carriage can be accomplished in many ways. One method involves the use of a sonic range sensor mounted at the front or rear of the machine. When aimed at the carriage, this device can detect the exact fore/aft location of the carriage and direct the motor speed accordingly. Another method involves running a tether from the carriage to a pulley on the back of the frame, then forward to a pulley on the front of the frame, then around a potentiometer, and back to the carriage. As the carriage moves fore and aft, the potentiometer increases and decreases the speed of the motor.

[0178] It may be desirable to allow the machine to be run in a program mode such that the user rides on a predetermined course shown on a display. In this case, the speed control system may automatically vary the speed of the dynamic element so as to change the fore/aft position of the user in anticipation of the user accelerating or decelerating. For example, if the program has a user riding up hill and approaching the top, the speed control system may speed up the dynamic element so that the carriage moves toward the back so that as the user reaches the top of the hill and the terrain becomes level, the user can accelerate without worrying about hitting the front stop.

[0179] Similar techniques can be applied toward the non-motorized versions of the invention. If a generator is used to control the dynamic element, a tachometer can be incorporated and used to control a variable load across the generator to maintain a constant speed. Similar to above, this system can also be made "intelligent". If a flywheel and friction band are used, a tether can be attached to the carriage to control pressure on the friction band such that as the carriage moves rearward, the friction increases, causing the flywheel to slow. Conversely as the carriage moves forward, the friction decreases causing the flywheel to speed up.

[0180] The present invention has been described as it relates to human motion simulating machines. Specifically, these have included, for example, skier machines, walking machines, climbing machines, rower machines and bicycle machines. Generally, these machines embody a means capable of allowing a user to traverse between ends of a frame wherein as the user is urged in one direction he propels himself in the opposite direction.

[0181] Turning now to the strength training attributes of the present invention, it will be appreciated that the previously discussed speed controlled motor will again be utilized. More particularly, the present invention includes at least one speed controlled motor which rotates a drive shaft. Mounted on the drive shaft is at least one one-way clutch spindle and recoil system. A flexible member such as a rope, cable, or belt engages the spindle which engages the one-way clutch such that when the flexible member is pulled, it spins the spindle in the direction of the drive shaft rotation locking the one-way clutch such that the spindle can spin only as fast as the rotating drive shaft. When the flexible member is released, the recoil mechanism causes the spindle to spin in the opposite direction, which releases the one-way clutch and recoils the flexible member.

[0182] As the user pulls on the flexible member and engages the one way clutch, he is restricted to pulling no faster than the rotational speed of the drive shaft will allow. For this reason it is necessary to maintain a tightly controlled motor speed. When the user is not pulling on the flexible member (rest stroke), the motor drives the drive shaft, however when the user pulls the flexible member (power stroke) with enough force to overcome internal resistance, he applies power to the drive shaft at which point a braking force is applied in order to keep the drive shaft from accelerating. This braking force varies depending on the amount of force applied by the user.

[0183] Ideally, the overall speed of the motor can be adjusted to allow for higher or lower intensity workouts. Once a speed is selected, maintaining a relatively constant drive-shaft RPM is necessary. When a poor speed controller is used and the motor speed varies by more than approximately 10%, the quality of the exercise is diminished because a portion of the user's work is dissipated by accelerating the drive shaft. This "dissipated" work adds a dull sensation to the user's experience. A 2 hp. dc motor powered by a 2 quad drive such as the 12M8-22001 by Gemini Controls works well for this application. Additionally, a flywheel will help maintain a uniform speed.

[0184] Prior art machines using a pull rope on a rotating shaft have relied on resistance means whereby torque is speed dependent. In other words, the faster the user pulls, the harder the resistance becomes. This acceleration reduces the ability of the user to exert a greater amount of force at the end of the stroke. In one embodiment, the present invention constantly adjusts torque to the system to allow for a constant speed such that only the torque changes as the user pulls harder or softer.

[0185] By adjusting the motor speed, the perceived amount of effort can be altered. A slower speed generally feels more difficult than a faster speed. It may be desirable to give a greater perceived difficulty at the end of the user's stroke when he can produce the most power. For example, the motor speed can be automatically slowed while the user exercises through his range of motion. This can also be accomplished by using a rope as a flexible member and wrapping it around a conical shaped spindle. When the rope is pulled it is retracted from a larger diameter to a smaller diameter thereby slowing in speed as it is retracted. Another method involves using a flat belt as the flexible member and wrapping it around a cylindrical spindle. When the belt is fully wound (upon itself), it is at a larger diameter than when it is fully unwound. By choosing different spindle diameters and belt thicknesses, various perceived force vs. range of motion profiles can be created.

[0186] In certain instances, it may be desirable to allow for the setting of a maximum allowable force output. For example, a patient recovering from an elbow operation may be advised to lift no more than 10 pounds. The present invention can be programmed to allow for an increased motor speed when a predetermined maximum amount of force is applied. For example, a maximum braking load can be set for the motor speed controller such that motor speed increases once the maximum braking force has been applied.

[0187] In one embodiment, illustrated in FIG. **28**, the strength machine **2800** includes four one-way clutch mechanisms **2802**. The motor drive **2804** and clutch assemblies are mounted to a base frame **2806** which includes at least one upright member **2808**. With the use of pulleys **2810**, two flexible members **2812**, are routed to the top of the upright member **2808**, and two flexible members **2812** are routed to the bottom of the upright member **2808** or the base frame **2806**. By attaching handles **2812** to the ends of the flexible members, various strength exercises can be performed.

[0188] By way of example, a user can exercise triceps by standing in front of the machine and pulling down on the upper handles. By reaching down and pulling up on the lower handles the user can exercise the biceps. When sitting in front of the machine the user can pull down on the upper handles to exercise the latissimus dorsi muscles, and by pushing up on the lower handles exercise the shoulders. Using a bench and lying down, the user can exercise back muscles with the upper handles, and chest with the lower handles.

[0189] The strength machine can be adaptable to be able to utilize opposing flexible members to enable the user to exercise opposing muscle groups simultaneously (within the same exercise set). More particularly, and as the embodiment shown in FIG. **29** illustrates, at least two pull ropes are attached at the handle end. Here, two upper pulley ropes **2830** are attached to two lower pulley ropes **2832** at a common bar **2834**. This allows the user to exercise two opposing muscle groups within the same cycle. For example, the user can grasp the bar and do a biceps curl, and when he reaches full flexion, he can rotate his hand grip and do a triceps push down. This feature makes the present invention more time productive than other strength training techniques. The user can also push the bar horizontally and exercise chest muscles, or pull the bar horizontally to exercise back muscles. Because the ropes will pay out at a fixed speed, the projectile of the bar will be guided in a horizontal path. This allows the user to feel greater stability which is important for older and physically challenged individuals. By varying the speed of the top vs. bottom ropes, different projectiles can be created. This can include complex projectiles formed by varying the speed of the motor(s) (located in the motor box **2836**) throughout the range of motion of the exercise. The machine can also be programmed to alternate speeds between opposing motions to create greater or lesser perceived effort. For example, one may wish to exercise biceps lightly and triceps vigorously. In this case, a motion sensor determines the direction of travel of the conjoined flexible elements. Motor speed is automatically slowed during the upward movement, and sped up during the downward movement.

[0190] Furthermore, the flexible member(s) can be attached to a linkage which is rotatably mounted to the frame. The user then grasps a portion of the linkage and is thus allowed to exercise through a predetermined arc of motion. Alternatively, the flexible member(s) may be attached to a slide on a rail. The user then grasps the slide and is thus allowed to exercise through a predetermined range.

[0191] Recent studies have suggested that adding an element of instability, such as vibration, to an exercise produces improved results including greater strength, greater bone density, and increased weight loss. With each vibration the body is forced to perform reflexive muscle actions. Vibration machines, which are relatively known in the art, provide a platform on which a user stands and performs various exercises. Some of these machines can vary the frequency, amplitude, and direction of the vibrations.

[0192] The present invention can be adapted to enable the use of vibration during exercise. This involves use of an instability mechanism which adds an acceleration and deceleration component to the flexible member. The instability can include various combinations of frequency and displacement applied to the flexible member. Conjoined flexible members can utilize a common instability mechanism or individual instability mechanisms to create unique vibrations in various planes at the grip. The instability mechanism can take on many embodiments however in all cases it is designed to allow for the rapid acceleration and deceleration of the flexible member as it is being paid out by the driver. An example of a typical oscillation might be 2 mm of overall displacement at a frequency of 40 hz.

[0193] In one embodiment, a powerful drive motor is used which can be driven in such a manner as to produce the oscillations directly by rapidly accelerating and decelerating during rotation. Another embodiment involves displacing the flexible member at a point of travel between the driver and the grip. A solenoid, motor, or other mechanical device capable of rapid movement can be used. For example, and referring now to the oscillating system **2900** of FIG. **30***a*, a solenoid **2902** can be attached to mechanically interfere with the travel of the flexible member **2904** such as by operating in a direction tangent **2906** to the flexible member. Oscillations are then felt by the user during manipulation of the grips/handles **2908** through the pulleys **2910**. Alternatively, and as the embodiment of the oscillating system **2920** in FIG. **30***b* illustrates, a motor **2922** or other mechanical device (such as a mechanical take-off from the drive motor) can be fitted with an offset hub **2924** and positioned to press against the flexible member **2926** and pulley **2928**. As the motor rotates, the offset hub pushes and then releases pressure against the flexible member upon every revolution. Another embodiment involves vibrating the entire machine. This can be done, for example, by mounting a motor with an offset weight on the driveshaft to the frame of the machine. As the motor spins, the offset weight causes the entire frame to vibrate thereby adding a vibrating component to the grip.

[0194] In any event, the amplitude of the vibration can be varied by varying the throw of the solenoid, the amount of offset on the offset hub, changing the proximity of the devices to the flexible members, etc. The frequency can be adjusted by varying the rate of the solenoid, or varying the speed of the motor.

[0195] Referring back to FIG. **28**, in order to measure the force application at each of the flexible members **2812**, stain gauges **2816** can be installed at various points, such as at the pulley contact points. This force information can be displayed (e.g. "25 pounds") **2818** such as in the form of multiple bargraphs, numeric readouts, charts, etc. Force output can also be derived by measuring the energy dissipated by the speed controller during braking. For example, if a generator circuit is used for braking, the amount of current produced is proportional to the force output of the user.

[0196] Optical encoder(s) **2820**, or the like, can be mounted on the spindles, pulleys, or other reference points to record the movement and direction of travel of the flexible members. This information can be translated to display range of motion, speed, etc. to the user. When this data is combined with the strain gauge data, force vs. displacement can be plotted and displayed for the user or therapist.

[0197] The user interface can include a so-called virtual coach which guides the user through a predetermined workout. Through voice commands or a display, the user will be instructed to perform specific strength moves. During these moves the machine can automatically alter the motor speed thereby changing the perceived resistance, count reps, record range of motion, record force applied during each rep, display comparisons of the present workout to previous workouts, and offer visual or audible coaching suggestions. For example, the display may graphically show an ideal force vs. displacement curve for a particular exercise which the user is encouraged to match. As the user performs the exercise, he can adjust his force output to match the profile on the display. The "virtual coach can be programmable by the user or a trainer/therapist to create an infinite variety of customized routines.

[0198] While particular embodiments of the invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made therein without departing from the invention in its broader aspects and therefore the purpose of the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

1. An exercise apparatus, comprising:
- a frame;
- a driver mounted on said frame and having an adjustable speed controller for controlling a constant predetermined speed; and
- at least one user engagable grip being coupled to said driver for resistive movement thereof through a one-way clutching mechanism whereby said mechanism engages said driver upon the user reaching said predetermined speed through actuation of said grip.

2. The exercise apparatus as defined in claim **1** wherein said driver is a speed controlled motor.

3. The exercise apparatus as defined in claim **1** wherein said speed controller includes a braking mechanism.

4. The exercise apparatus as defined in claim **1** wherein said grip includes a free handle and cord that provides the user with a full range of motion during use.

5. The exercise apparatus as defined in claim **4** wherein said grip is located at user adjustable heights and/or widths.

6. The exercise apparatus as defined in claim **1** wherein said grip includes a handle on a rail, said grip further including a cord.

7. The exercise device as defined in claim **6** wherein said grip is located at user adjustable heights and/or widths.

8. The exercise apparatus as defined in claim **1** wherein said grip is a linkage rotatably mounted to the frame, said grip further including a cord.

9. The exercise apparatus as defined in claim **8** wherein said grip is located at user adjustable heights and/or widths.

10. The exercise apparatus as defined in claim **4**, **6**, or **8** wherein said clutching mechanism includes a recoil for said cord.

11. The exercise apparatus as defined in claim **1** wherein said speed is user adjustable.

12. The exercise apparatus as defined in claim **1** wherein said speed is automatically adjusted based on the selected workout.

13. The exercise apparatus as defined in claim **1** further including a force measuring device for measuring the force output of the user.

14. The exercise apparatus as defined in claim **13** wherein said speed is automatically adjusted based on input from the force measuring device.

15. The exercise apparatus as defined in claim **13** wherein said force measuring device is a strain gauge.

16. The exercise apparatus as defined in claim **13** wherein said force measuring device derives force output of the user by measuring the energy dissipated by said speed controller.

17. The exercise apparatus as defined in claim **1** further including a displacement measuring device to measure the displacement of the grip.

18. The exercise apparatus as defined in claim **17** wherein said speed is automatically adjusted based on input from the displacement measuring device.

19. The exercise apparatus as defined in claim **1** including at least two grips positioned to allow the simultaneous exercise of opposing muscle groups.

20. The exercise apparatus as defined in claim **1** including display means for displaying at least one of speed, force applied, range of motion, number of repetitions, and past performance information.

21. The exercise apparatus as defined in claim **1** including display means capable of displaying an optimal force vs. displacement chart along with an actual force vs. displacement chart.

22. The exercise apparatus as defined in claim **1** including display means capable of displaying an optimal force output with an actual force output.

23. The exercise apparatus as defined in claim **1** including display (or voice) means capable of displaying user instructions including which exercise to perform.

24. The exercise apparatus as defined in claim **1** including means for adjusting grip speed during exercise to vary the perceived effort during a stroke.

25. The exercise apparatus as defined in claim **24** where speed is varied by changing motor speed.

26. The exercise apparatus as defined in claim **24** where said driver includes a conical shaped spindle.

27. The exercise apparatus as defined in claim **24** where said driver includes a flat belt concentrically wrapped around a spindle.

28. The exercise apparatus as defined in claim **13** including means for speeding up the driver when a predetermined force is exceeded.

29. The exercise apparatus as defined in claim **19** including means for providing different speeds for each of the at least two grips.

30. The exercise apparatus as defined in claim **29** wherein the different speeds are determined in response to input from said displacement measuring device.

31. The exercise apparatus as defined in claim **29** wherein said means involves using multiple motors.

32. The exercise apparatus as defined in claim **29** wherein said means involves using spindles with different diameters mounted on the drivers.

33. The exercise apparatus as defined in claim **19** including means for varying the speed of the at least two grips throughout the range of motion to create complex projectile paths of the grips.

34. The exercise apparatus as defined in claim **1** including instability means for causing the grips to vibrate.

35. The exercise apparatus as defined in claim **34** wherein the frequency and/or magnitude of said vibration is user adjustable.

36. The exercise apparatus as defined in claim **34** wherein the frequency and/or magnitude of said vibration is machine adjustable.

37. The exercise apparatus as defined in claim **34** wherein a different frequency or magnitude of vibration can be supplied to each grip.

* * * * *

US008057368B1
APPENDIX NN

(12) **United States Patent**
Lyszczarz

(10) **Patent No.: US 8,057,368 B1**
(45) **Date of Patent: Nov. 15, 2011**

(54) **THREE-POINT ADJUSTABLE MULTI-PURPOSE EXERCISE MACHINE**

(76) Inventor: **Grzegorz Lyszczarz**, London (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 8 days.

(21) Appl. No.: **12/185,919**

(22) Filed: **Aug. 5, 2008**

Related U.S. Application Data

(60) Provisional application No. 60/963,497, filed on Aug. 6, 2007.

(51) **Int. Cl.**

A63B 21/062	(2006.01)
A63B 3/00	(2006.01)
A63B 21/068	(2006.01)

(52) **U.S. Cl.** **482/103**; 482/42; 482/96; 482/138; 482/142

(58) **Field of Classification Search** 482/92–96, 482/99, 101–103, 133, 134, 138, 142, 908, 482/42; D21/673, 675, 676
See application file for complete search history.

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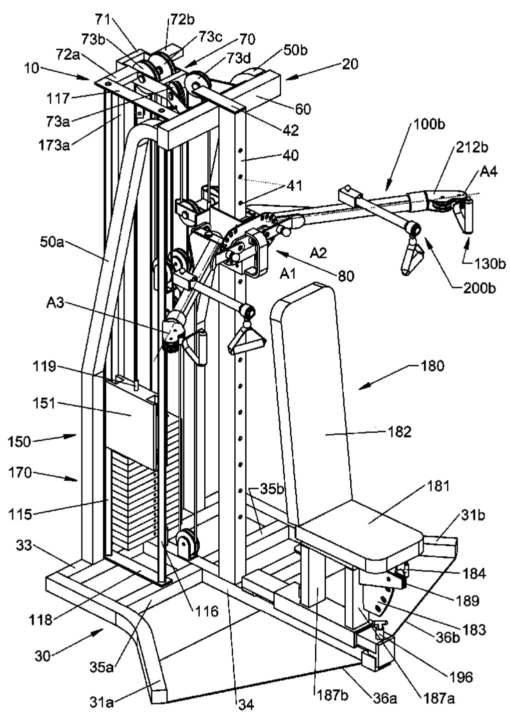
Primary Examiner — Loan Thanh
Assistant Examiner — Victor K Hwang
(74) *Attorney, Agent, or Firm* — Walter J. Tencza, Jr.

(57) **ABSTRACT**

A multipurpose exercise machine requiring only three points of adjustment centrally located. It has a one point height adjustment and two adjustments for the rotating arm assemblies. Dip and chin up bars are attached to the arm assemblies. The machine contains an integrated swingable workout bench. Through the use of a pulley system and counter balance assembly, the cable system maintains tension and provides a constant length of cable.

13 Claims, 12 Drawing Sheets



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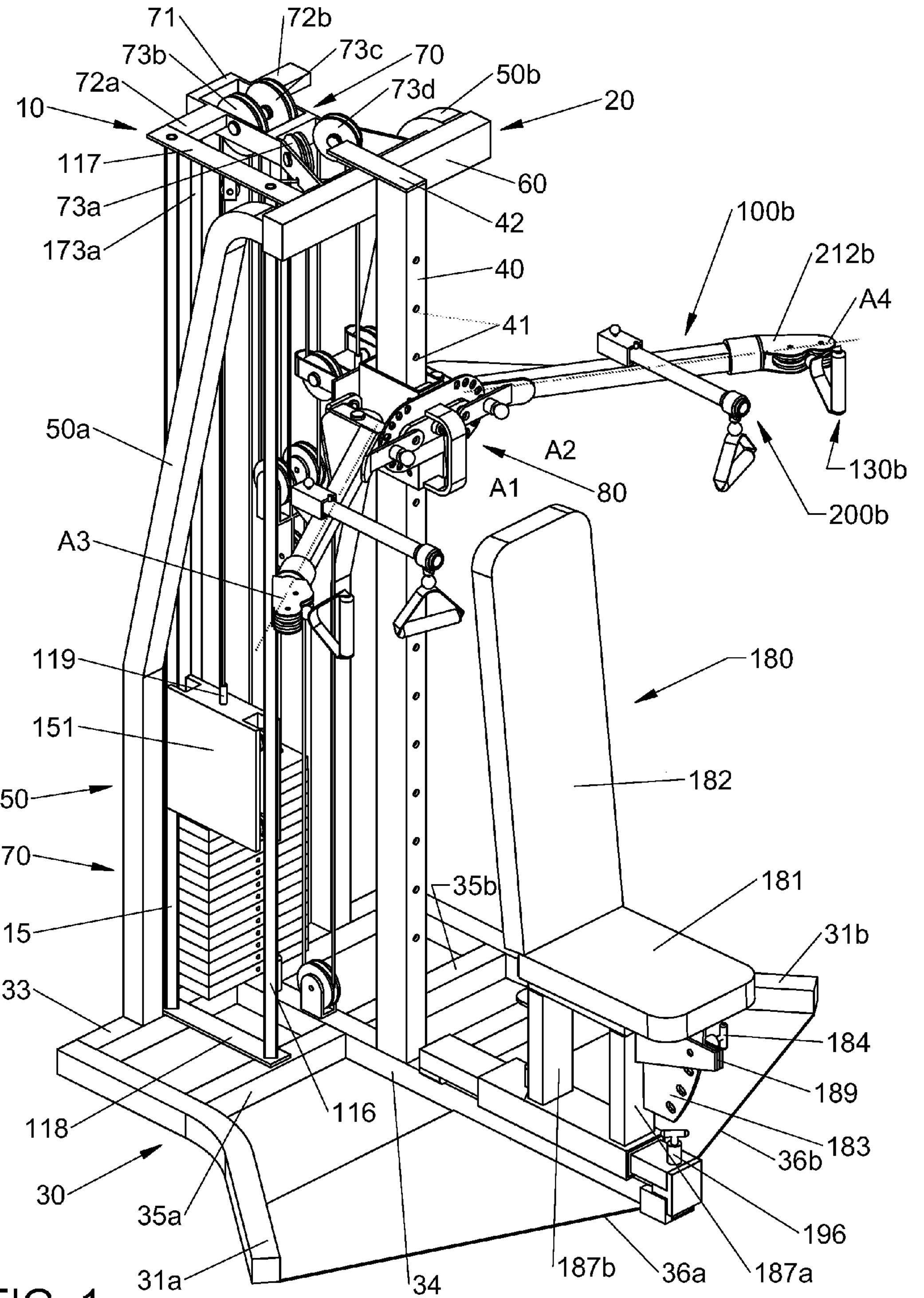
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A2
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A1
80
200b
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35b
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187a
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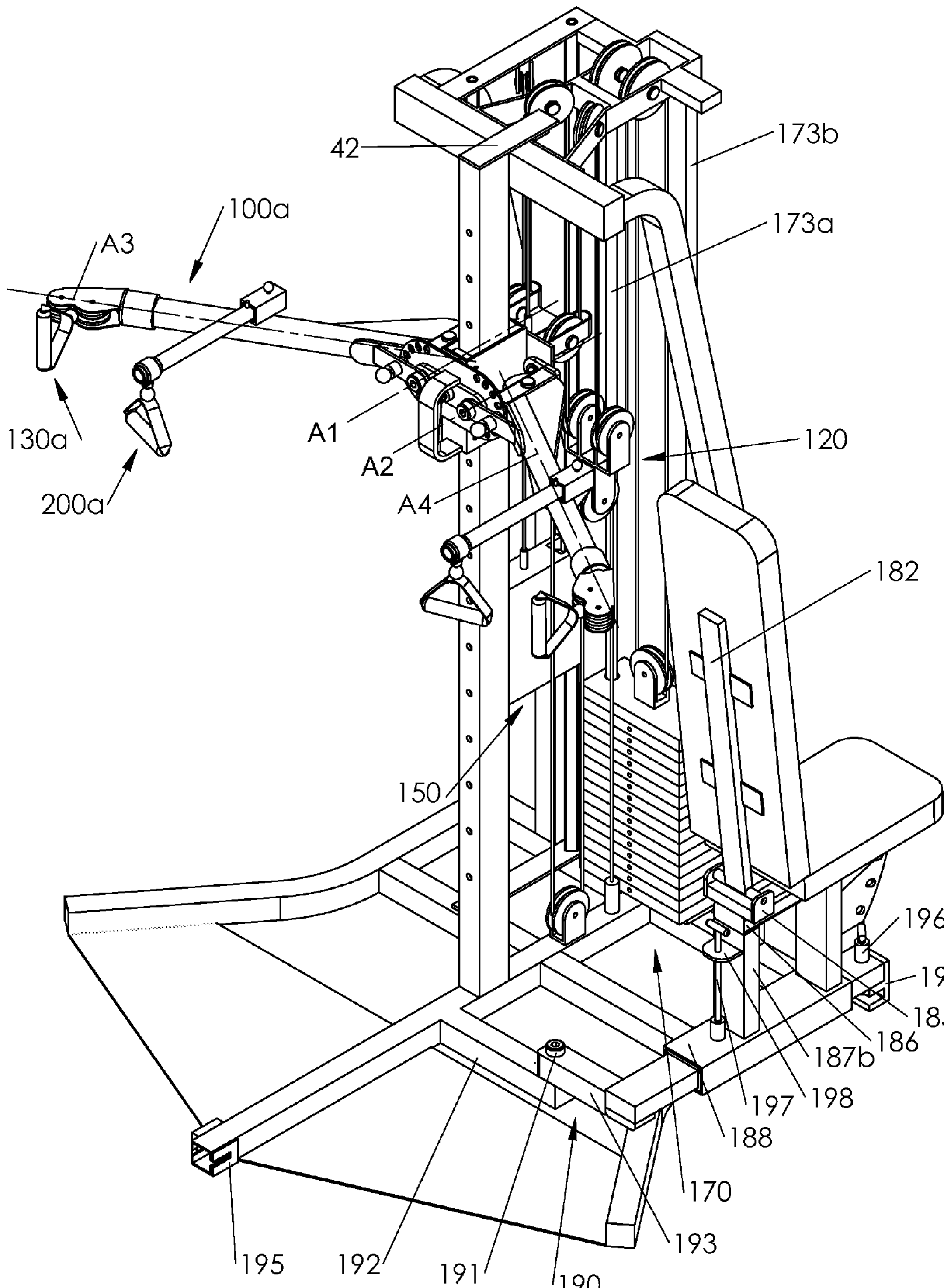
FIG. 1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170
193
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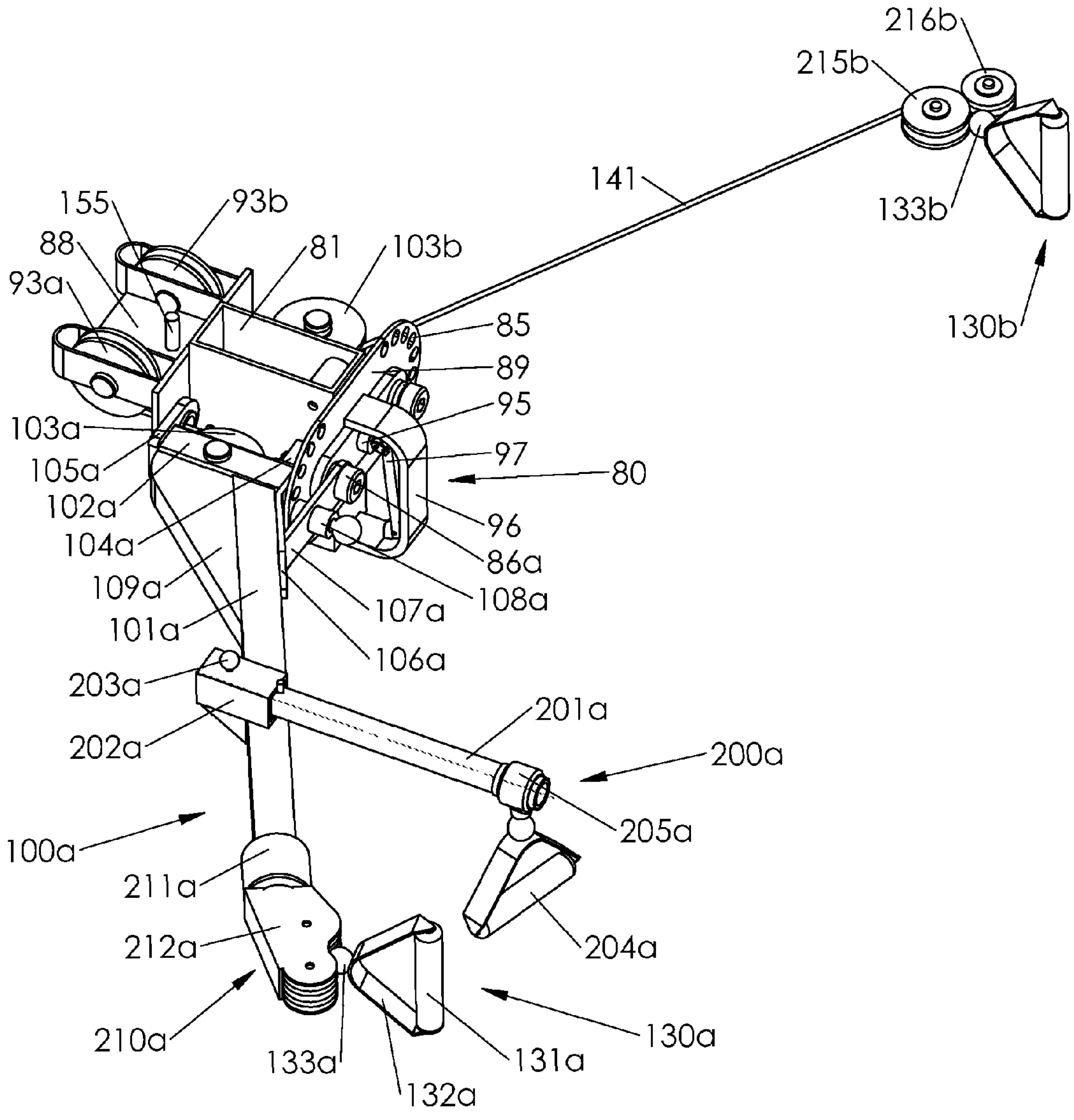
192
191
190

FIG. 2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96
104a
86a
109a
108a
107a
101a
106a
203a
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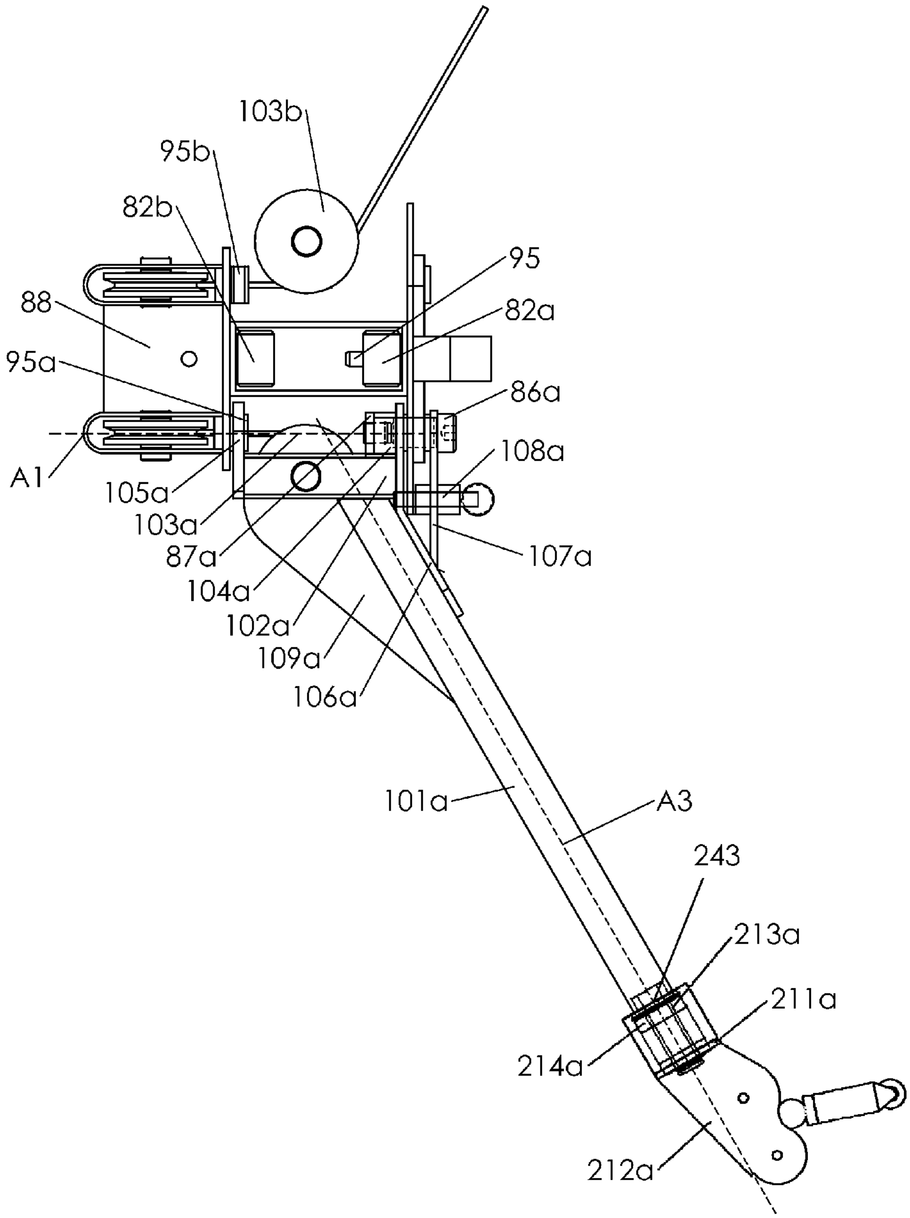
131a
132a

FIG. 3a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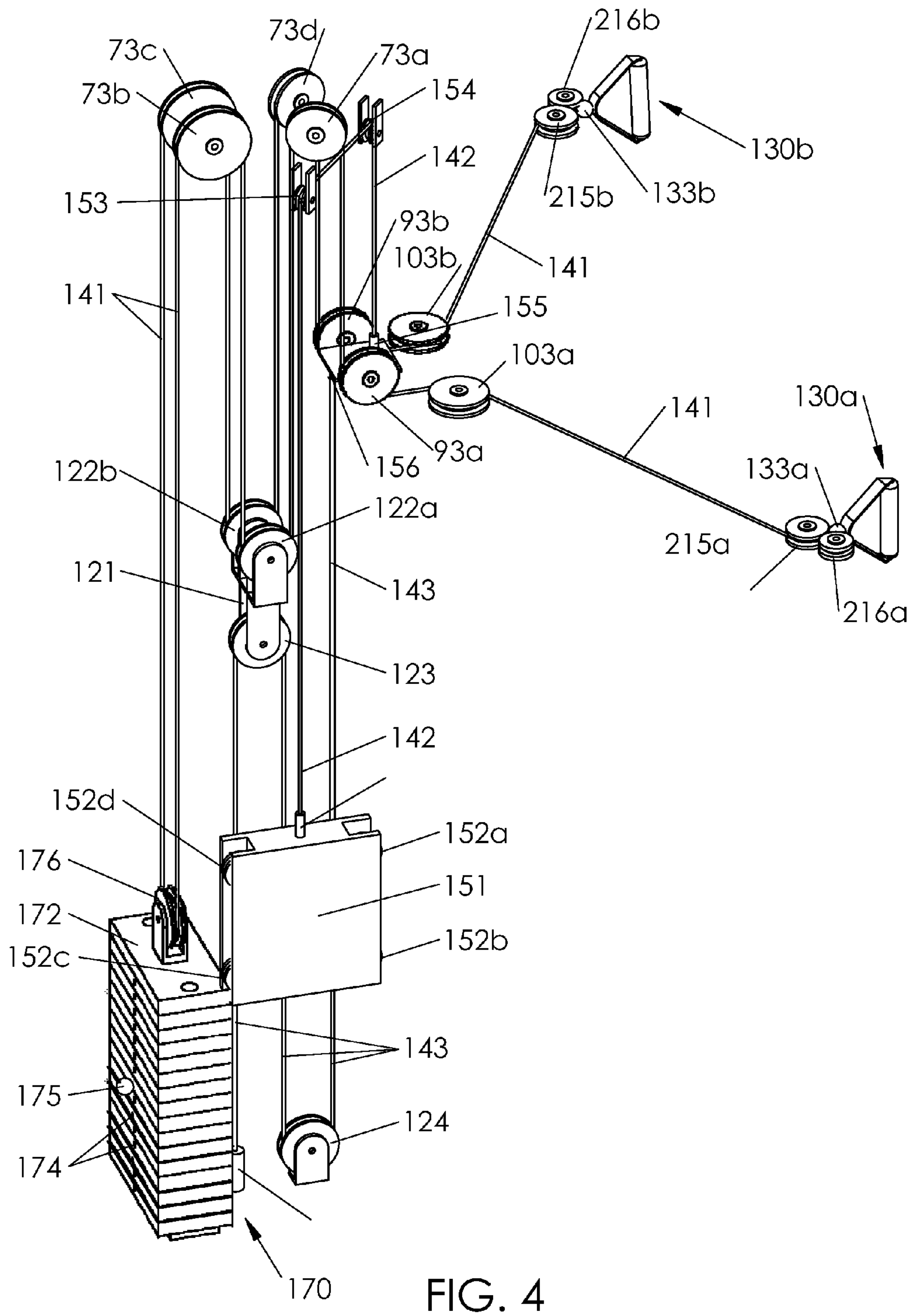
106a
101a
A3
243
213a
211a
214a
212a

FIG. 3b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130a
156
93a
122b
133a
122a
215a
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170

FIG. 4

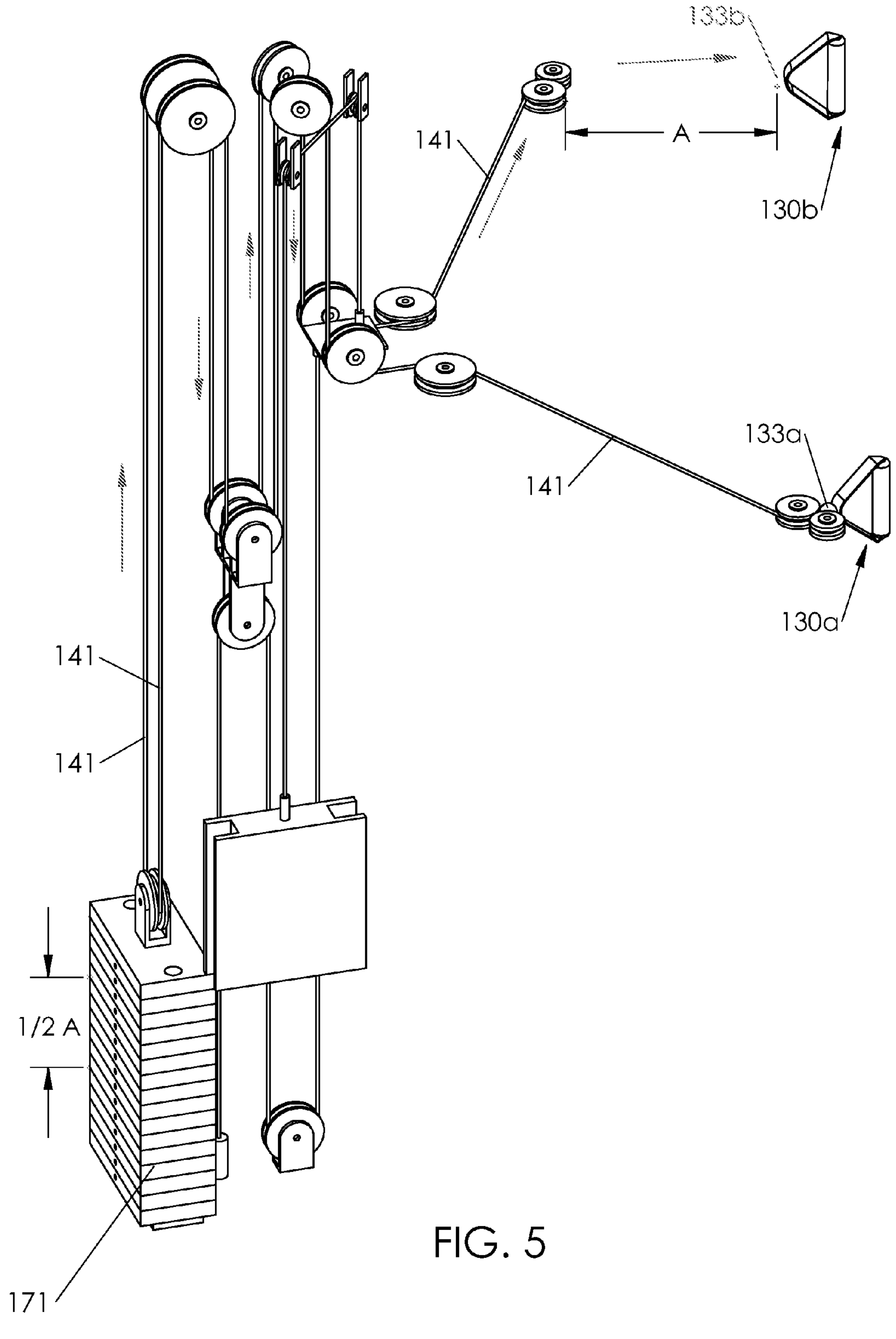
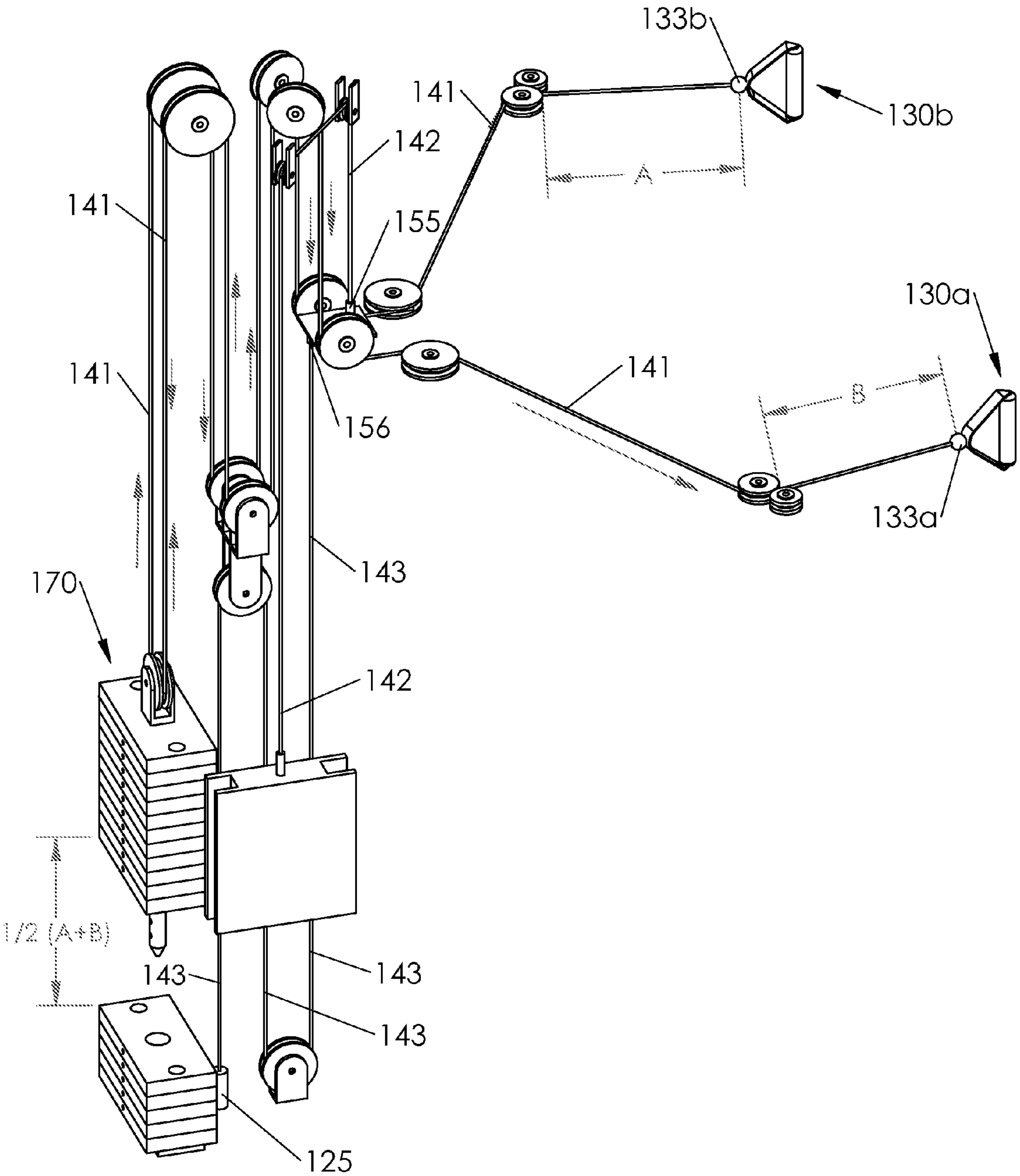


FIG. 5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141
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A
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155
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B
156
133a
143
170
142
1/2 (A+B)
143
143
143
125

FIG. 6

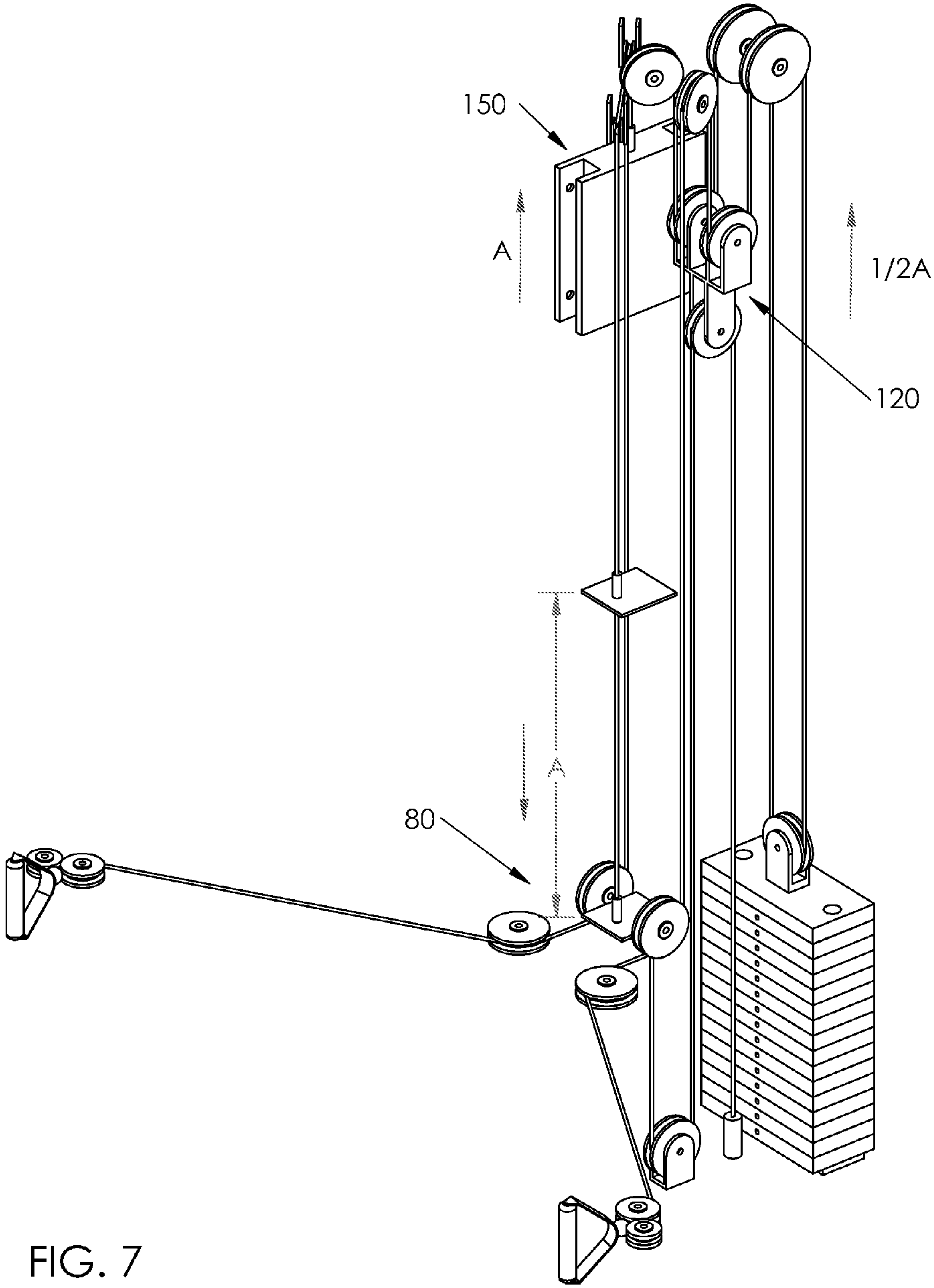


FIG. 7

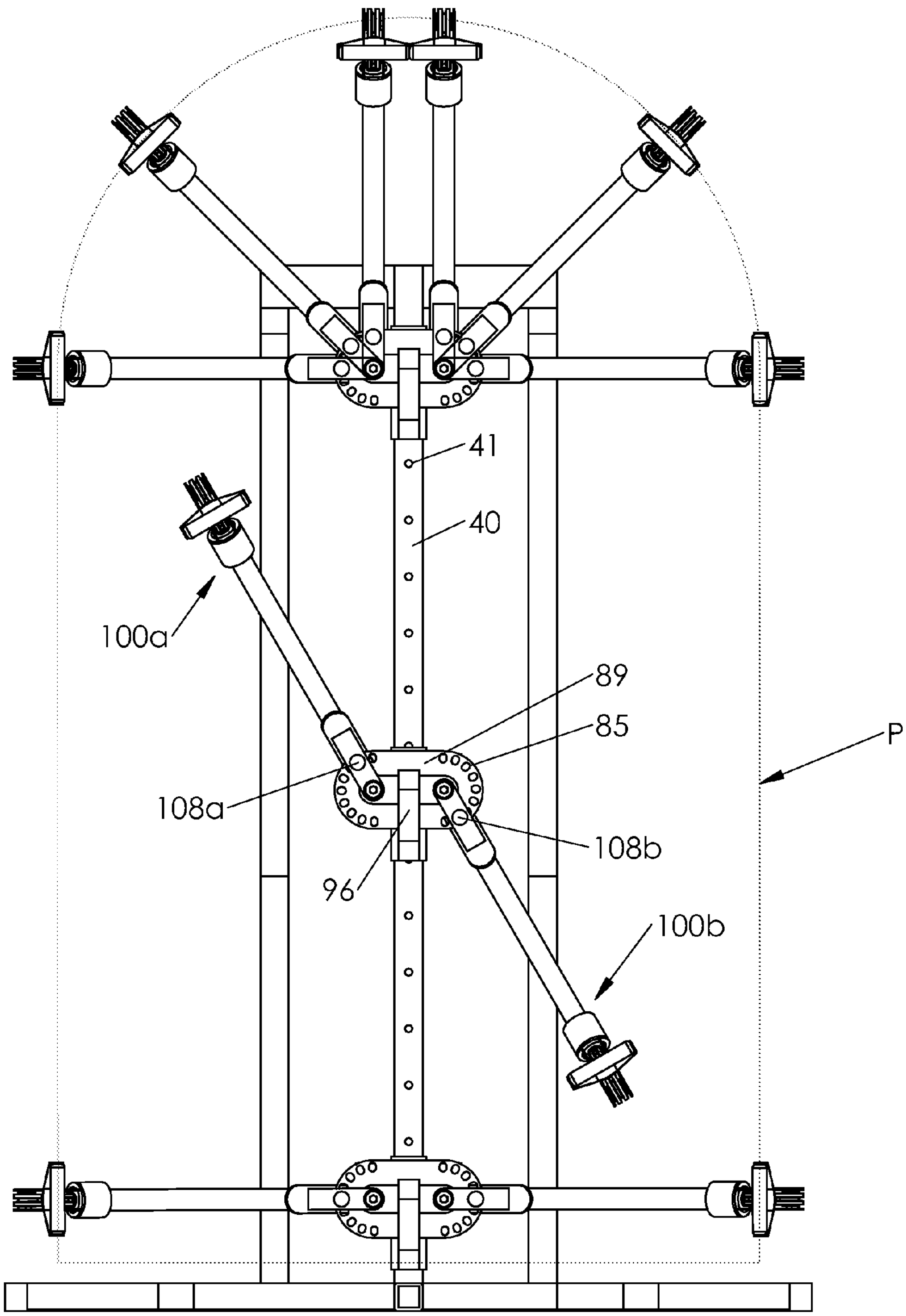


FIG. 8

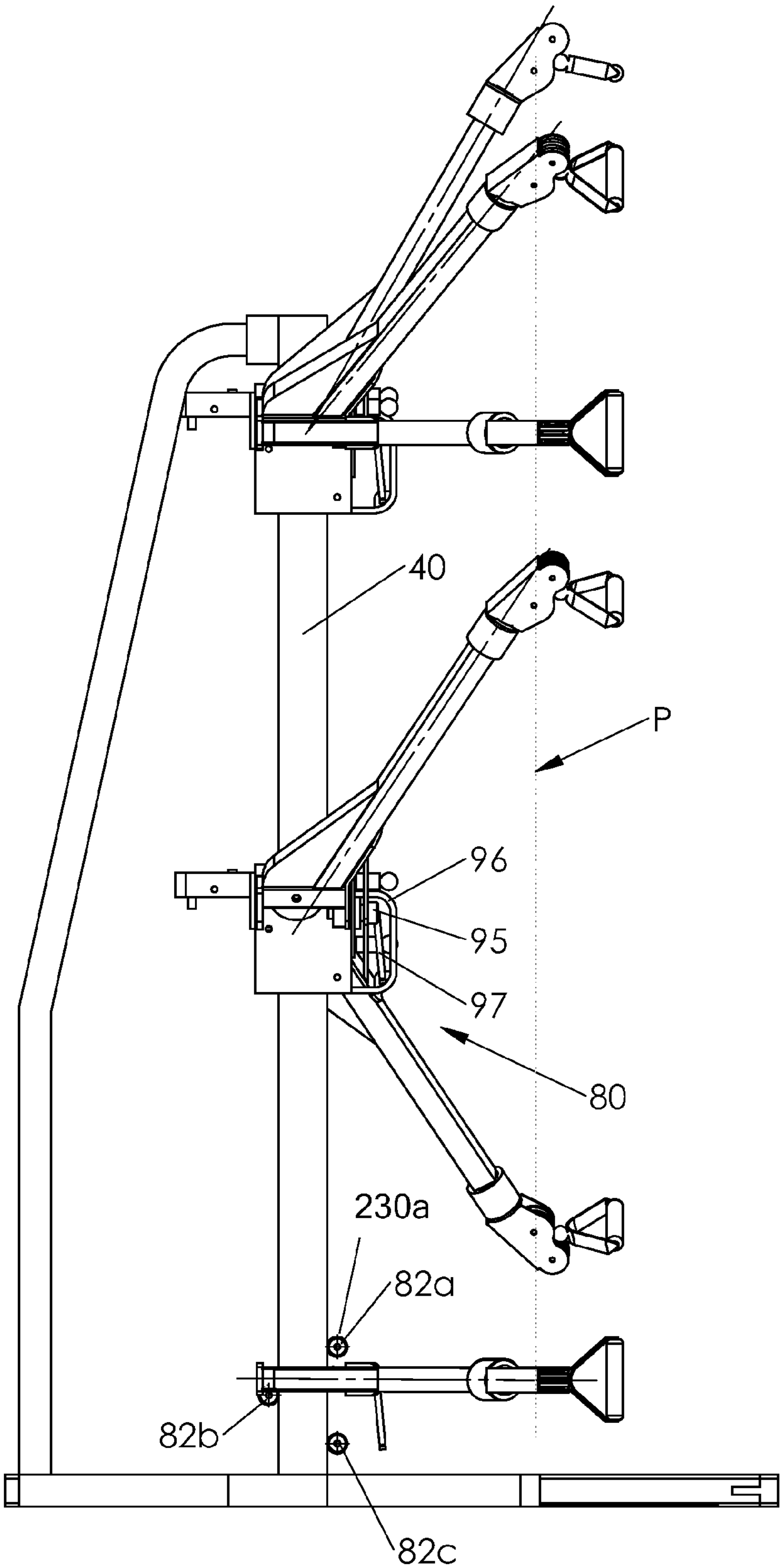


FIG. 9

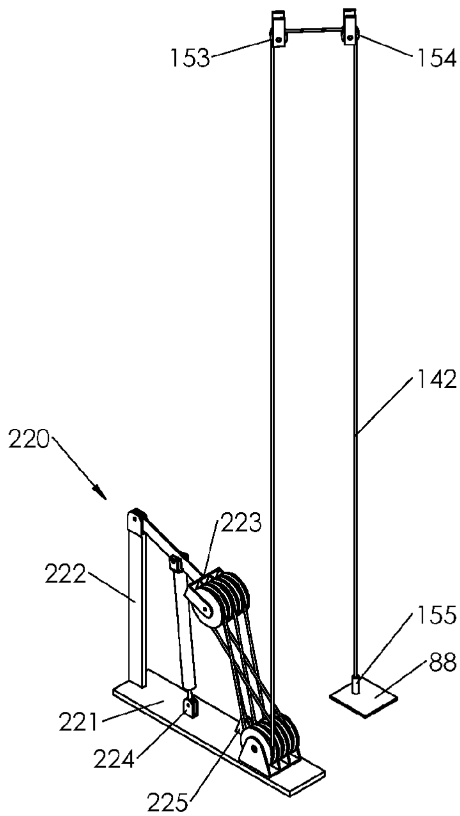


FIG. 10a

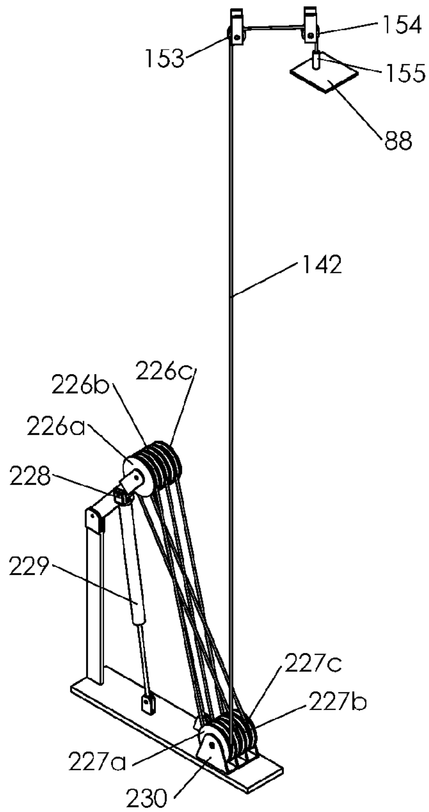
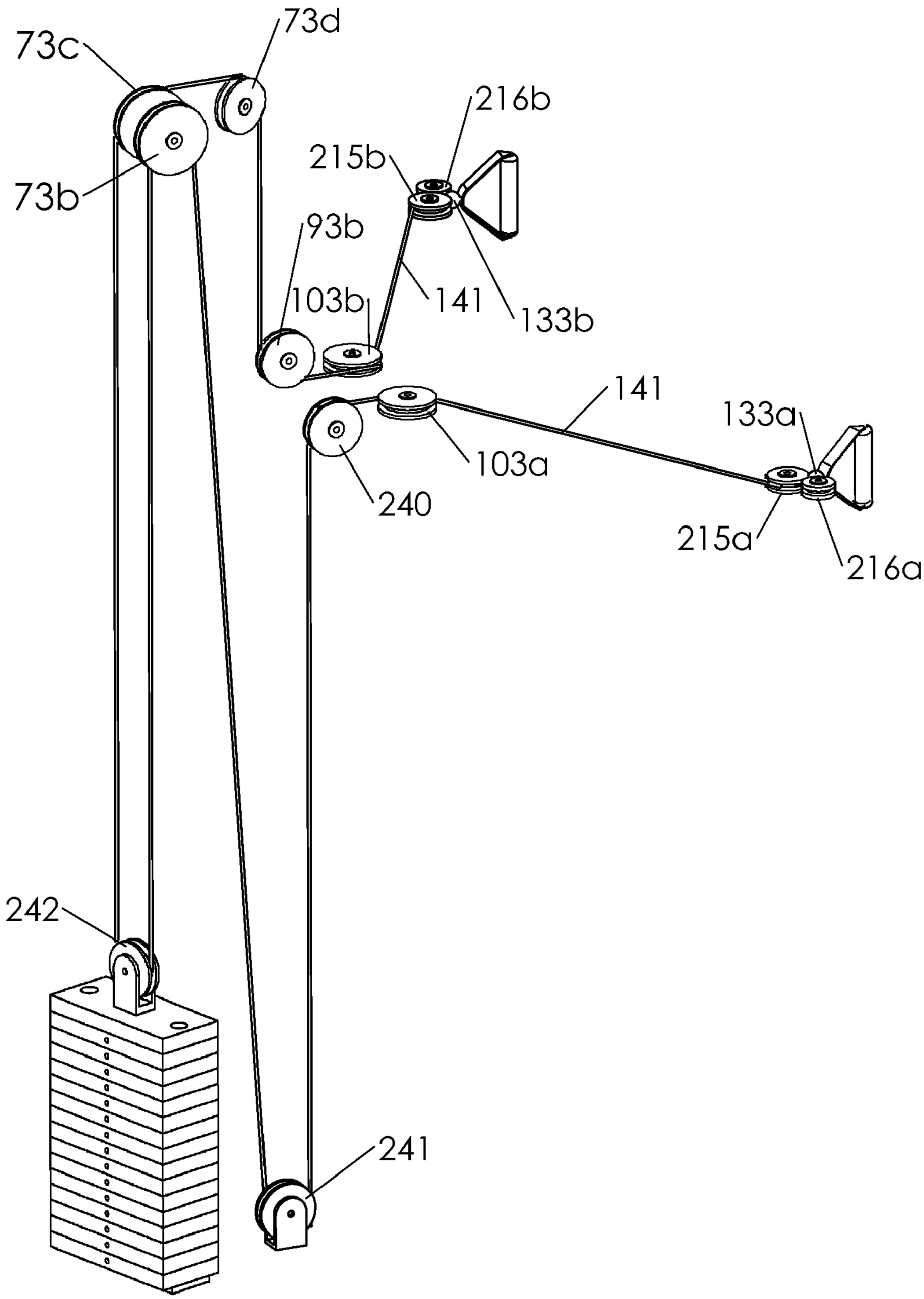


FIG. 10b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240
215a
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242
241

FIG.11

THREE-POINT ADJUSTABLE MULTI-PURPOSE EXERCISE MACHINE

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. provisional patent application 60/963,497, filed Aug. 6, 2007.

FIELD OF INVENTION

This invention relates to exercise machines, specifically multipurpose exercise machines used for strength, aerobic, stretching or rehabilitation exercises.

BACKGROUND OF THE INVENTION

Multi-functional weight training equipment which enables multiple exercise routines in various positions on a single machine has been designed in the past. Exercise devices that have been prevalent in recent years, commonly known as functional trainers, use adjustable components in order to create new positions for exercise. Thanks to their ability to transform themselves into different configurations, they can mimic most of the traditional multi-station machines and free weights with just a few adjustments. There are many types of functional trainers on the market today, and they use several different methods for adjusting their components. Most of them use adjustable arms, sliding carriages with pulleys or multiple pulleys mounted at different locations on the machine. Also, some of them can be used with the workout bench. The number of exercises that can be performed on particular machine depends on how many different configurations it can be transformed to. More configurations provide more exercise options for the user. The goal is to create as many new positions for exercise as possible with the use of a single machine. Recently there have been some attempts to incorporate the use of functional trainers with workout benches. This is a very desirable combination because it provides additional exercise options and with support of the bench, higher resistance can be used. There is a big demand for such versatile equipment, especially in the fast growing market of home gym fitness.

Unfortunately, the majority of these devices are large, cumbersome and difficult to handle. Some of them have limitations on positions available for exercise, and others have complicated and time consuming adjustments. Most of them lack versatility and are used only for strength exercises with one mode of resistance. Machines that combine a stationary bench with a functional trainer have limitations because the presence of the bench prohibits many exercises.

For example, U.S. Pat. No. 6,238,323, Nordic Track® 360° Home Gym, and Nordic Track® PT3 Trainer represent a group of functional trainers that use similar methods of adjusting their components to create new positions for exercise. They all use very long and stationary mounted adjustable arms that can rotate 180 degrees about a generally horizontal axis to different locked positions. These are adjusted such that their ends are very close together at the top and bottom of their arcs (arms in vertical position) and are widely spread when the arms are in the middle of their arcs (arms in horizontal position). The shortcoming of the described method of adjustment is that there are limitations on the positions that their arms can take. More specifically they are not suitable for exercises that require the ends of the arms to be relatively close together and at about waist height of the exerciser (such as a typical rowing movement). Also, changing the height of the arms requires adjustments at two locations. Arms are very long (in order to provide for high and low pulley exercises) and awkward to handle. With the arms in a vertical position, there is not enough room in front of the machine for exercises that require pure vertical resistance (lat pull down, military press, squat) and user have to adjust their body position for these particular exercises, applying a vertical and an unnecessary horizontal force.

A different method for creating new positions for exercise is used in exercise machines presented in United States Patent Application Publication Numbers US 2003/0017918 A1 and US 2002/0013200 A1 (Known as Cybex FT360S) and commercially available Northern Lights Chilcat Cable Motion Trainer, Vectra VFT 100, Tuff Stuff MFT-700 and Paramount Functional Trainers Models PFT-200 and FT-150. With this method of adjusting the arms, narrow and wide grips at different heights are available, which greatly increases number of possible positions for exercise. Arms can rotate about a generally horizontal and vertical axis to different locked positions such that their ends move in three dimensional manners. Because of that the users are forced to move closer or further away from the machine for different exercises. For example, for exercises that require the ends of the arms to be relatively close together and at about waist height (such as a typical rowing movement) the distance between the user and the machine will be equal to the length of the arms.

The shortcomings of the described adjustment method are that three dimensional changes in the position of the very long arms require a lot of extra space, which is often not available. Three dimensional adjustments can be confusing, awkward and can intimidate new users or potential buyers. Creating new positions for exercise using three dimensional systems require adjustments at four locations, two for changing the height and two for changing the width of the arms which can be complicated and time consuming, especially for multiple consecutive users of different sizes (height).

The use of the bench with three dimensional arm positioning method requires changes of the bench position almost with every new arm location. Repositioning of the bench involves multiple lifting and can be time consuming and tiring.

Another method of adjusting components of the exercise machine to create new positions for exercise is presented in U.S. Pat. No. 6,447,430 B1, which shows the machine having two weight stacks, a pair of carriages mounted on the frame and adopted to be adjusted to different heights and pulley blocks on the carriages. Each of the pulley blocks are free to pivot about two axis of rotation so that the pulley blocks can follow the cables and remain aligned with the cables regardless of the direction in which the cables are pulled. The shortcomings of the machine described above are that the system is using complicated three dimensional adjustments of the arm position. Locations for adjustments are distant from each other and placed on two separate posts, forcing the user to walk between them to complete the desired changes, which can be time consuming. Height adjustment requires changes at two separate locations distant from each other. In order to change the height and the width, the user has to complete a total of four adjustments at two separate locations distant from each other, which is complicated and time consuming. The machine has a large structure because it uses two posts for height adjustment and two separate weight stacks, which greatly adds to the weight of the entire assembly. Carriages are heavy to handle and placing them at the highest level is difficult because adjustment points are above the head of the average size user.

The arms of this machine swing in a horizontal plane, and because of that the maximum available height for exercise is limited by the height of the posts with the sliding carriages. Despite that the machine is built very tall, even at the highest position of the carriages, the highest position for exercise is at face level for the average sized user.

The machine is equipped with a dip bar and a chin up bar, but because they are installed at a fixed height they might be difficult to use for a below average size user. They provide only one fixed resistance equal to the body weight of the user, which might not be suitable for many beginner or intermediate level exercisers. Similar methods of adjustments as described in U.S. Pat. No. 6,447,430 may be seen in machines like Body-Solid Functional Training Centre GDCC200, Northern Lights Functional Trainer, Pacific Fitness 3.23 Functional Trainer, Torque Fitness F5 and Life Fitness FSDAP.

Up to this time, there have been some attempts of combining machines that provide many exercise options by using the adjustability of their components with bench exercises. Combinations like this can provide exercises with more resistance from different locations and directions with user defined paths of exercise movements. Some machines have even added body weight exercises using dip bars, and/or a chin-up bar.

Examples of machines that combine a functional trainer with the use of a bench are for example Bowflex Revolution that provides machine with two arms that can rotate 180 degrees about a horizontal axis mounted at a fixed level behind a multi functional and adjustable exercise bench. Nordic Track® PT3 and Nordic Track® 360° Home Gym uses the same principals for arm adjustments like Bowflex Revolution but have higher mounted and longer arms and have a removable seat instead of a fold up bench.

Other examples are Body Craft mini/XPress and Body Craft XPress Pro which consist of two arms that can rotate 180 degrees and are mounted behind a seated exercise bench. Arms are much shorter (than Bowflex Revolution and PT3) and are located at a lower level. All of them use similar arm adjustment methods which does not provide positions for exercises that require starting points inside of the circle described by the ends of the arms. Specifically, the only available positions for exercise are located on the circumference of that circle. Therefore, the major shortcoming of these machines is the limitations on the positions that their arms can take. More specifically, they are not suitable for exercises that require narrow grip at about waist height for the exerciser (such as typical rowing movement). Also, the machines are relatively low for many standing exercises and because the arms are configured too close to the front of the machine there is not enough space for exercises that require pure vertical resistance. Despite that the bench folds up for storage it prevents the user from performing many user defined exercises, or these exercises must be done in awkward body positions.

Because their arms rotate generally in vertical plane, they do not provide enough room for exercises that require pure vertical resistance (squats, military press). In order to utilize those exercises, extra floor pulleys need to be used, or exercisers have to adjust their body positions to align with the angle of the cable.

Another shortcoming of these machines is that they do not economically use the length of the cable. This is mainly because the starting positions of many exercises that are often distant from the ends of the arms. Available cable length is reduced by the distance between the starting position for exercise and the ends of the arms.

The presence of the bench during exercises that do not require the use of the bench prohibits many exercises and many of them have to be performed in awkward positions. The removable seat of the PT3 machine does not provide enough adjustability. The arms of Body Craft mini/XPress do not provide for high pulley exercise and due to this, additional lat pull down assembly had to be added.

Body weight exercises are very popular, effective and are often recommended as an additional variation in anybody's workout routine. Prior art machines have been designed in the past that incorporate dip bars and chin up bars as sub-assemblies built into a main structure of a multi-purpose exercise machine. Usually they are built as an addition to the entire structure or in the form of a fold up design.

Shortcomings of such an arrangement are that it increases the size and the cost of the unit, beside that, most of the prior art dip bars and chin up bar assemblies are installed at fixed heights and they might be difficult to use for a below average size user. Also, they provide one fixed resistance equal to the body weight of the user which might not be suitable for many beginner or intermediate level exercises.

SUMMARY OF THE INVENTION

A 3 point arm adjustment multipurpose excersize machine is disclosed which provides a very effective method of creating new positions for exercise. The new machine can provide different height positions for arm exercises combined with different configurations of the adjustable arms providing multiple widths for low and high pulley exercises as well as multiple heights for narrow and wide grip exercises. All of the prior art machines require adjustments at four locations (points) to achieve a similar number of positions available for exercise.

One point height adjustment with unchanged configuration of arms greatly shortens transition time between exercises and can simplify more complex workout routines, such as circuit training. With one point height adjustment, exerciser can switch in seconds from low to mid or even high pulley exercises which with prior art, equipment would require at least two separate adjustments.

The present machine provides a very simple adjustment system, which makes all the adjustments for new positions for exercise easily predictable by the exerciser and it greatly simplifies the use of the bench which does not need to be moved to fit new arm positions.

Arms adjustments can be made with three adjustment points placed at one convenient location. High pulley level can be adjusted by each exerciser to meet their individual needs. With the presented adjustment method for creating new positions for exercise, handles at the ends of arms can be brought within a view inches from the starting position for exercise which allows for greater economical use available for exercise cable length. This ability can be used and appreciated in the fields of rehabilitation and physiotherapy where precise positioning, proper form and execution of the path of the exercise is very important.

Another advantage of the present invention is that it offers a wide range of bench exercises as well as freeing space when bench is not needed. The bench can swing from the storage position to exercise position.

The present invention may have one or more of the following advantages: It has a reduced number of adjustment points; it has new uses for traditional components; it is more versatile; it has simpler, faster, easier to handle and accessible from one location adjustments; it has a one point height adjustment; it offers full range of undisturbed bench or functional exercises without sacrificing their proper form; one adjustable structure can be used for different types of workout and with different modes of resistance; various lifting or pulling exercises that require pure vertical resistance can be performed without additional attachments or changing of the body position of the exerciser; provides multiple positions and adjustable resistance for body weight exercises; can be used with at least one swing-away workout station; and it has more economical use of the cable length.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying figures depict and disclose examples of the invention and examples of various positions and uses of the invention wherein:

FIG. **1** is a front right perspective view of an embodiment of the exercise machine of the present invention, with the arms in a generally horizontal position;

FIG. **2** is a front left perspective view of the exercise machine with the swing away workout station in a generally retracted position;

FIG. **3***a* is a perspective view of the carriage with one arm hidden, showing carriage components in greater detail;

FIG. **3***b* is a top view of the carriage with one arm hidden, showing arm mountings, bushings and carriage rollers along the handle pulley assembly showing components in greater detail;

FIG. **4** is a schematic view of the cabling independent of the frame and arm structures where the handles of both arms are not pulled out from the ends of the arms;

FIG. **5** is a schematic view of the cabling independent of the frame and arm structures where the handle of one arm is pulled out and the handle of the other arm is not pulled out and with the weight selected is raised to half of the distance the handle is pulled;

FIG. **6** is a schematic view of the cabling independent of the frame and arm structures where the handles of both arms are pulled out from the ends of the arms with the weight selected raised to half of the combined distance the handles are pulled;

FIG. **7** is a schematic view of a simplified carriage and arm assembly in a lower position on the centre post with a counterbalance and cable compensator adjusted accordingly;

FIG. **8** and FIG. **9** are front and right side views, respectively, of the exercise machine with multiple carriage positions and configurations shown to illustrate the plane of possible exercises;

FIG. **10***a* and FIG. **10***b* is a schematic of an alternative counter balance assembly.

FIG. **11** is an alternative embodiment for maintaining tension and a constant length of cable available for exercise.

DETAILED DESCRIPTION OF THE INVENTION

The present invention will now be described more fully, in which preferred embodiments of the invention are shown. The disclosed embodiment is merely exemplary of the invention, which may be embodied in various forms. Therefore the details disclosed herein are not to be interpreted as limited, but merely as the basis for the claims and as a basis for teaching one skilled in the art how to make and/or use the invention.

With reference to FIG. **1**, from the view point of the exerciser sitting on bench assembly **180** with back resting on the back support **182**, the assemblies and components on the "right" side of the exercise machine **10** will be denoted by suffix "a", and the "left" side of the exercise machine **10** will be denoted by suffix "b".

With reference to FIG. **1** and FIG. **2**, a multipurpose exercise machine **10** is disclosed. The exercise machine **10** further includes major features, namely, an upstanding frame **20**, a carriage and arm assembly **80** with two rotating arm assemblies **100***a*, **100***b*, a pair of handle units **130***a*, **130***b*, a pair of adjustable chin-up and dip bar assemblies **200***a*, **200***b*, a counterbalance assembly **150**, a cable length compensator assembly **120**, a weight stack assembly **170**, and a swing away workout station **190**.

The frame further consists of a base **30**, a vertical centre-post **40**, two vertical support posts **50***a*, **50***b*, a upper frame reinforcement **60**, and an upper pulley assembly **70**.

The base **30** further consists of two side members **31***a*, **31***b* connected via cross member **33**. Base plate **36***a* and **36***b* is connected to two side members **31***a* and **31***b*. The central reinforcement **34** is connected at the midpoint of cross member **33**. Two small cross members **35***a*, **35***b* are connected in line and in between side members **31***a*, **31***b*. The lower end of vertical centre post **40** is connected to central reinforcement **34** and its upper end is attached to the midpoint of the upper frame reinforcement **60**. Both ends of the upper frame reinforcement **60** are connected to the second ends of the vertical support posts **50***a*, **50***b*. The first ends of the vertical supports **50***a*, **50***b* are mounted to the cross member **33**.

Referring to FIG. **1**, upper pulley assembly **70** comprising a pulley mount **71**, guide rod mounting brackets **72***a*, **72***b*, and pulleys **73***a*, **73***b*, **73***c*, **73***d* which are mounted via bolts to the pulley mount **71**.

Referring to FIG. **1**, **4**, counter balance assembly **150** will be described. The counter balance assembly **150** comprising a counter weight **151** with guide rollers **152***a*, **152***b*, **152***c*, **152***d* operatively connected with guide rails **115**, **116**. Guide rails **115**, **116** are positioned vertically and parallel to each other. Upper and lower reinforcements **117**, **118** mount together guide rails **115**, **116** at the lower end to the small cross member **35***a* and cross member **33**, and to upper reinforcement **60** and guide rail mounting bracket **72***a* at the upper end. Cable anchor **119** connects the first end of cable **142** to the counter weight **151**. Cable **142** extends over transfer pulleys **153**, **154** and connects via cable anchor **155** to the upper surface of pulley mount **88** of carriage and arm assembly **80** (FIG. **3***a*). Counterbalance cable **142** interconnects counter weight **151** with carriage and arm assembly **80**.

Referring now to FIG. **1**, **2**, **4**, **5**. The weight stack assembly **170** which is mounted on cross member **33**, comprising a operating rod **171**, a weight stack pulley **173** connected to the operating rod **171**, a plurality of weight plates **172** which are mounted on guide rods **173***a*, **173***b* with their bottom ends mounted on cross member **33**. Operating rod **171** and weight plates **172** have aligned openings **174** through which a pin **175** can be inserted to connect weight plates **172** to operating rod **171**. When a given weight plate **172** is connected to operating rod **171**, that plate and any plates above it will be lifted with the operating rod **171**.

The upper ends of the guide rods **173***a*, **173***b* of weight stack assembly **170** are attached to brackets **72***a*, **72***b* of the second end of upper pulley assembly **70**. The first end of upper pulley assembly **70** is attached to the midsection of upper reinforcement **60**.

Those skilled in this art will recognize that although a weight stack is the preferred structure for providing resistance to the exerciser, other resistance-imparting structures such as friction-imparting devices, variable viscosity devices, air drag-based resistance devices, pneumatic devices, elastically bending rods, gas springs, magnetic devices, hydraulic devices, and the like, may also be employed with an exercise machine of the present invention.

Referring to FIG. **3***a*, **3***b*, **9**, the carriage and arm assembly **80** comprising a sleeve **81** with rollers **82***a*, **82***b*, **82***c* (FIG. **9**), bolt **230***a*, arm selector plate **89** and pulley mount **88**. Sleeve **81** and rollers **82***a*, **82***b*, **82***c* are operatively connected via bolts. Rollers **82***a*, **82***b*, **82***c* are positioned and sized to provide for rolling operation between carriage and arm assembly **80** over the vertical centre post **40**. Arm selector plate **89** with both ends semicircular in shape includes near its perimeter a series of position apertures **85** arranged in a semi-circle at circumferential increments of 22.5 degrees, although other increments are also suitable. Circular holes (where bolt **86***a* is inserted) in the arm selector plate **89** are coincident with the holes in the pulley mount **88** and axis A**1** to provide mounting and rotation points for arm assembly **100***a* about the axis A**1**. The centre of the semi-circle defined by the apertures **85** is also coincident with axis A**1**. Cable anchors **155** and **156** (FIG. **4**) are mounted on the top and bottom of the horizontal plate of the pulley mount **88**. Pulleys **93***a*, **93***b*, are attached via bolts to the pulley mount **88**. The axis of rotation of pulleys **93***a*, **93***b* are perpendicular to axis A**1** and positioned such that the axis of the cable **141** when engaged with pulleys **103***a*, **103***b*, coincides with axis A**1**. In this arrangement, rotation of the arm assembly **100***a* about axis A**1** does not change tension in the cable **141**. A carriage selector pin **95** is operatively connected with handle **96** via linkage **97** and spring (not shown). Insertion of carriage selector pin **95** into one of the height position apertures **41** in the centre post **40** prevents vertical movement of the carriage and arm assembly **80**. The carriage and arm assembly **80** may be locked in any position along the vertical centre post **40** and such locked positions may be of any size (4 inches shown).

The arm assemblies **100***a*, **100***b* are mirror images of one another about a vertical plane as shown in FIG. **3***a* that extends through the centre of the carriage and arm assembly **80**. In the interest of clarity and brevity, only one arm assembly **100***a* will be described in detail herein; those skilled in this art will appreciate that this discussion is applicable to the arm assembly **100***b*.

Referring now to FIG. **3***a*,**3***b*, the arm assembly **100***a* further includes arm **101***a* with arm reinforcement **109***a* connected at its mounted end to the arm mounting bracket **102***a* consisting of front and rear supports **104***a*, **105***a*, respectively, pulley **103***a* rotatably mounted between them, a front reinforcement **106***a*, and a bracket **107***a* with spring loaded arm selector pin **108***a*. The centre of the circular holes in the front support **104***a*, rear supports **105***a*, front reinforcement **106***a*, and the unattached end of bracket **107***a* are coincident with axis A**1** (FIG. **1**, **2**) and provide mounting and rotation points for the arm assembly **100***a* about axis A**1**. The spring loaded arm selector pin **108***a* is mounted in the midsection of the bracket **107***a* and the pin is sized and configured such that in its extended position can be received in one of the position apertures **85** and in the openings of the front reinforcement **106***a*. Insertion of the pin into one of the position apertures **85** and opening in the front reinforcement **106***a*, prevents rotation of the arm assembly **100***a* about the axis A**1**. Retracting the pin **108***a* from one of the position apertures **85** and openings in the front reinforcement **106***a* makes rotation of the arm assembly **100***a* about axis A**1** possible.

Arm assembly **100***a* is rotatably mounted with the carriage and arm assembly **80** about axis A**1** (FIG. **1**, **2**) via bolt **86***a* at the front end and sleeve bushing **95***a* at the rear end. Locking nut **87***a* secures the connection and enables adjustment of the rotational resistance by tensioning of nut **87***a* and bolt **86***a*.

As shown in FIG. **1**, **2**, the arms extend forward at a chosen angle from a pivot point located on the carriage and arm assembly **80**. FIG. **9** shows the arms angled at 30° from the vertical, but those skilled in the art will recognize that any practical purposely chosen angle can be applied without departing from the spirit of the invention. That is, the arms are angled forward to provide enough space for performing standing or seated exercises when a pure vertical resistance is required to deliver proper exercise form in exercises such as shoulder presses or standing squats.

Referring to FIG. **1**, **2**, **3***a*, **3***b*, removable chin-up and dip bar assemblies **200***a*, **200***b* are attached at the mid-section of arm assemblies **100***a*, **100***b* respectively. Bar assembly **200***a* comprising a bar **201***a* and sleeve **202***a* which are fixed to the mid-section of the arm **100***a*. Bar **201***a* can be removed or attached to the arm **100***a* using pin **203***a*, connecting sleeve **202***a* with bar **201***a*. Bars are in a generally horizontal position and can be adjusted to various widths by rotating arm assemblies **100***a*, **100***b* about axis A**1**, A**2** and securing with selector pin **108***a* to the selector plate **89**. The height of the bars **200***a*, **200***b* can also be adjusted by changing height of the carriage and arm assembly **80** and securing with height selector pin **95**. Handle straps **204***a* or other attachments can be attached to the rotatable connection **205***a* at the end of the bar **201***a* to provide for more exercise options. This adjustable arrangement can accommodate exercisers of different sizes and fitness levels. Intensity of the exercise can be changed by changing the height or the width of the bars and/or attachments.

Bars **200***a*, **200***b* eliminate the need for specially designated chin-up or dip stations which are achieved here without changing the size of the machine and using the same adjustable structure for several different applications.

Referring still to FIG. **3***a*, **3***b*, the arm assembly **100***a* also includes pulley assembly **210***a* comprising bearing sleeve **211***a* with pulley housing **212***a*, which is rotatably mounted over the hollow shaft **213***a*, attached to the arm **101***a*, such that it is free to rotate relative to the arm **101***a* about axis A3 (parallel with the longitudinal axis of the arm **101***a*). At least one bearing **214***a*, although two are shown with the present invention, are mounted such that the outer ring is attached to the sleeve **211***a* and an inner ring attached to the hollow shaft **213***a* and secured with external snap rings, such as external snap ring **243**, shown in FIG. **3***b* (other external snap ring(s) not shown) at the end of the hollow shaft **213***a*. Two pulleys **215***a*, **215***b* (FIG. **4**) are rotatably mounted with bolts inside pulley housing **212***a*, and positioned so that they permit passage of the cable between them. Pulley **215***a* is mounted such that axis of rotation A**3** is coincident with the axis of the cable **141** when engaged with the pulley **215***a*. Pulley **216***a* is preferably smaller than pulley **215***a* and is positioned such that it engages with the cable **141** when the applied pulling angle of cable **141** can no longer be supported by pulley **215***a*. Pulleys **215***a*, **216***a* always guarantee cable engagement at most commonly used angles for a particular exercise.

Referring now to FIG. **3***a*, the handle unit **130***a* will be described with the understanding that the description is equally applicable to the handle unit **130***b*. The handle unit **130***a* includes handle **131***a*, flexible strap **132***a* attached to each end of handle **131***a* and formed into a loop and stopper **133***a* that is fitted over strap **132***a* and attached to the end of cable **141**. From this position it can be grasped by an exerciser, and when pulled will cause rotation of pulley assembly **210***a* about axis A**3** (FIG. **1**, **2**) and allow the direction of the cable to align with the direction of the pulling force exerted by the exerciser via handle unit **130***a*. Different handle attachments can be used with present invention, for example, different lengths of soft single grip handles, ankle straps, horse shoe handles, rope attachments and different types of pull down bars.

Referring now to FIG. **1**, **2** the swing-away bench assembly will be described. Those skilled in the art will understand that the described bench is an example of a workout station which can be used with the present invention and that the subject of the invention is the method of bringing the workout station to the exercise position and removal of the entire station (not partial) to the storage position.

Referring now to FIG. **1**, **2** bench assembly **180** will be described. Bench assembly **180** comprising seat **181** coupled with back support **182** at the pivot bracket **185** which is mounted on seat support **186**. Two vertical supports **187***a*, **187***b* are attached to the seat support **186** at the top end and to the sliding sleeve **188** at the bottom end. Tilt selector plate **183** with tilt selector pin **184** attached to selector bracket **189** is mounted at the front of the vertical support **187***a*. Slide selector pin **197** is attached to sliding sleeve **188** and guided by holding bracket **198** attached to vertical support **187***b*. Bench assembly **180** allows for angular adjustment of seat **181** and back support **182** about pivot bracket **185** using tilt selector pin **184** inserted retractably in one of the openings in tilt selector plate **183**. Depth adjustment of the bench assembly **180** is also provided and can be accomplished by changing position of sliding sleeve **188** mounted over swing able arm **193**. Position of sliding sleeve **188** can be selected and secured with retractably mounted slide selector pin **197** inserted in one of the selector holes (not shown) in the swing-able arm **193**.

Described above bench assembly **180** is just an exemplary workout station that can be utilized with present invention and is used to describe a concept of creating an actual multi station exercise machine by bringing in specific workout stations that can be stored at both sides of the machine from storage position to the exercise position and use them as a regular stationary workout station, for example, bench press exercises can be done with bench assembly **180** in workout position (FIG. **1**) or with bench assembly **180** swung to storage position (FIG. **2**) and the freed space in front of the machine can be utilized for a number of undisturbed functional exercises (FIG. **8**, **9**).

Those skilled in this art will appreciate that the described above bench assembly **180** is just one of many possible types of workout benches that can be used with the present invention and can be stored on either sides and is used here as an example to explain the concept and method of creating combined multi-station exercise machine and functional trainer all in one without increasing space requirement and using just the original footprint of the present invention. Almost any commonly used types of exercise benches or stationary attachments can be used with present invention including benches with leg extension attachment, fold-up type benches with adjustable and removable back support and rowing capability.

Referring now to FIG. **1**, **2** when bench assembly **180** (or any other suitable bench) is connected to a swing able arm **193** it creates swing-away workout station **190**, comprising entire bench assembly **180** connected to the swing able arm **193** with sleeve **188**. Bench assembly **180** can also be connected with swing able arm **193** with bolts, welts, or clamps and those skilled in this art will appreciate that the sleeve connection is just an example to better explain the concept of present invention and shouldn't be limited to such. Swing-away workout station **190** further comprising pivot pin **191** connecting swing able arm **193** with one end of the stationary mount **192** which is attached to the central reinforcement **34** at the other end. Swing able arm **193** can be locked at the workout position with retractable locking pin **196** connecting lock **194** located at the end of the swing able arm **193** to the stationary lock receiver **195** located at the end of the central reinforcement **34**. With locking pin **196** retracted, swing-away workout station **190** can be moved to storage position on the side of the present invention. The pivotal connection between stationary mount **192** and swing able arm **193** via pivot pin **191** provides a delivery system for most benches or workout stations that when attached to the swing able arm **193** can be brought to workout position (FIG. **1**) or from workout position to storage position (FIG. **2**). The described above components of the delivery system are designed so that swing able workout station **190** when moved to or from workout position, rarely interferes with arms **100***a*, **100***b* and when in workout position there is still enough room provided for most of the adjustments of arms **100***a*, **100***b* and carriage and arm assembly **80** needed for different exercises.

Operation

Referring now to FIG. **1**, **2**, **4** the operation of the present invention will now be described. Single cable **141** couples both of the handle units **130***a*, **130***b* with the weight stack assembly **170**. Cable **141** extends from the handle unit **130***a*, in between pulleys **216***a*, **215***a* through bearing sleeve **211***a* coincident with axis A**1**, through arm **101***a*, and engages with pulley **103***a* mounted between front and rear supports **104***a*, **105***a* of the arm mounting bracket **102***a*. Cable **141** passes through sleeve bushing **95***a*, coincident with axis A**1** and engages with pulley **93***a* mounted at the pulley mount **88** of carriage and arm assembly **80**. Pulley **93***a* can be moved vertically (up or down) with the carriage and arm assembly **80** without changing the tension in cable **141**. Cable **141** then travels upwardly and engages and passes over right front pulley **73***a* of the upper pulley assembly **70**. After passing pulley **73***a*, cable **141** travels downwardly, engages and passes below pulley **122***a* of cable compensator assembly **120**. The cable then travels upwardly and passes over right rear pulley **72***a* of the upper pulley assembly **70**. From there, the cable **141** travels downwardly, engages, and passes below weight stack pulley **173** and travels upwardly to the left rear pulley **72***b* of the upper pulley assembly **70**. Cable **141** then passes over pulley **72***b* and travels downwardly, engages, and passes below upper left compensator pulley **122***b* of cable compensator assembly **120**. Cable **141** then travels upwardly, engages, and passes over left front pulley **73***b* of the upper pulley assembly **70**. Cable **141** then travels downwardly, engages, and passes below pulley **93***b* mounted at pulley mount **88** of carriage and arm assembly **80**. Pulley **93***b* can travel vertically (up or down) with carriage and arm assembly **80** without changing the tension of cable **141**. Cable **141** then travels along axis A**2**, engages with pulley **103***b*, and travels along axis A**4** of arm **100***b*. Cable **141** extends through pulley housing **212***b* between pulleys **215***b*, **216***b* and terminates at handle **130***b*.

FIG. **5**, **6** show one of the selected positions for exercise. The exerciser can grasp one or both of the handle units **130***a*, **130***b*, and pull them away from the ends of arms **100***a*, **100***b*. The grasping can be accomplished by one or both of the exercisers hands or feet as desired for the given exercise. The respective ends of cable **141** are provided with stoppers **133***a*, **133***b*. As those skilled in the art will readily appreciate that stoppers **133***a*, **133***b* control the motion of cable **141** to allow exercise by pulling one end of the cable separately or both ends at the same time. FIG. **5** illustrates the use of just one handle unit **130***b*. When one end of the cable **141** is pulled at the handle unit **130***b* the second end is anchored at the stopper **133***a*. Force exerted at handle unit **130***b* transfers through cable **141** to weight stack assembly **170** and causes the selected weight to rise. In the event that only one hand or foot is used the illustrated arrangement of the pulleys reduces the selected resistance by fifty percent. (e.g. For each ten pounds of weight selected, the exerciser experiences five pounds of resistance.) And for every distance traveled by the end of the cable **141**, weight stack assembly **170** will travel half of that distance (marked as A and ½A in FIG. **5**).

In the event that both handles **130***a*, **130***b* are used at the same time, handle units **130***a*, **130***b* are engaged and pulled away from their respective arms **100***a*, **100***b*. When the exerciser uses both hands or feet, the arrangement of the pulley train transfers one hundred percent of the pre-selected resistance at weight stack **170** to handle units **130***a*, **130***b*. (e.g. For each ten pounds of weight selected, the exerciser experiences ten pounds of total resistance typically five pounds in each handle unit **130***a*, **130***b*.) FIG. **6** shows an example when both handles are used at the same time. When handle units **130***a*, **130***b* are pulled at different distances, than the distance travelled by the weight stack is equal to ½(A+B), where A and B are the distances travelled by handle units **130***a*, **130***b*, respectively. When the distance travelled by the handle units **130***a*, **130***b* is equal (distance A equal distance B) the distance travelled by the weight stack is equal to the distance travelled by one of the handles.

Normally vertical adjustment of the carriage and arm assembly **80** would change tension in cable **141** and the length of cable available for exercise. Cable compensator assembly **120** is used to maintain the tension in cable **141** and a constant length of cable available for the exercise. Cable **141** at its midsection creates a downward U-shape loop between pulleys **73***a*, **73***b*, **72***a*, **72***b* at the top and engages with pulleys **122***a*, **122***b* of the cable compensator assembly **120** at the bottom of the loop. Cable compensator assembly **120** interconnects cable **141** with anchor cable **143** via pulleys **122***a*, **122***b*, **123** rotatably mounted to bracket **121**. Anchor cable **143** interconnects carriage and arm assembly **80** via pulleys **124**, **123** and cable anchor **125**, with frame member **34**. Cable **141** and anchor cable **143** interact together via cable compensator assembly **120**. When carriage and arm assembly **80** is moved upward or downward from any location on vertical post **40**, cable compensator assembly **120** travels in the opposite direction and one half of the distance traveled by the carriage and arm assembly **80**. Anchor cable **143** anchors cable compensator assembly **120** in fixed position at any pre-selected height of the carriage and arm assembly **80** and enables cable **141** to transfer resistance from weight stack **170** (source of resistance) to the handle units **130***a*, **130***b* used by exerciser. Cable compensator assembly **120** compensates both halves of cable **141** at the same time without changing the tension or length of the cable available for exercise.

Referring now to FIG. **11** the alternative embodiment for maintaining tension and a constant length of cable available for exercise will be described. Cable **141**, anchored between pulley **215***a*, **216***a* with a stopper **133***a* at one end, extends along axis A**3** and engages pulley **103***a*. It travels along axis A**1** over the top of pulley **240**, travels downwardly and engages and passes below pulley **241**. Cable **141** then travels upwardly and engages and passes over the right rear pulley **72***a* and extends downwardly passing below the weight stack pulley **173** and travels upwardly to the left rear pulley **72***b*. It then extends horizontally and engages and passes over the left front pulley **73***b* and travels downwardly and engages and passes below pulley **93***b*. Cable **141** then travels along axis A**2**, engages with pulley **103***b* and travels along axis A**4**, extends between pulleys **215***b*, **216***b* and terminates at the stopper **133***b*. Pulleys **240** and **93***b* can travel vertically (up and down) with the carriage and arm assembly **80** without changing the tension of cable **141**. During adjustments cable **141** engages and travels along pulley **241**, **72***a*, **173**, **72***b*, **73***b*, while anchors **133***a* and **133***b* remain at their original positions.

Referring to FIG. **1**, **2**, **3***a*, **4**. In order to provide for safe and effortless vertical adjustment of the carriage and arm assembly **80**, counterbalance assembly **150** is provided. The counterbalance assembly **150** comprising a counterweight **151**, rollers **152***a*,**152***b*,**152***c*,**152***d* upper reinforcement **117**, lower reinforcement **118**, a pair of guide rails **115**,**116**, and transfer pulleys **153**,**154**. The guide rails **115**,**116** connect at the top of upper reinforcement **117** and at the bottom of lower reinforcement **118**. The counterweight **151** and rollers **152***a*, **152***b*, **152***c*, **152***d* are operatively connected and sized to provide rolling operation with guide rails **115**,**116**. Cable **142** is attached to cable anchor **155** of pulley mount **88**. Cable **142** extends upwardly, engages, and passes over transfer pulley **154** which is mounted to the underside of cover plate **42** which is attached to upper frame reinforcement **60**. Cable **142** then travels horizontally, engages, and passes over transfer pulley **153** mounted to upper reinforcement **117** and extends downwardly and terminates at cable anchor **119** attached to counterweight **151**.

Carriage and arm assembly **80** is interconnect via cable **142** and transfer pulleys **153**, **154** with counterweight **151**, and during vertical adjustments of the carriage and arm assembly **80** they travel the same distance but in opposite directions. The weight of the carriage and arm assembly **80** is approximately equal to the weight of the counterweight **151**. Those skilled in this art will readily appreciate the described above counter balance assembly **150** is used to explain the operation of present invention as there are other methods which could be used without departing from the spirit of the invention. For example; devices that combine pulleys with gas springs. Referring to FIG. **10***a*, **10***b* alternative counterbalance assembly **220** can be used instead of counter balance **150**. Alternative counter balance assembly **220** comprising base plate, **221**, stationary arm **222**, movable arm **223**, gas spring cylinder **229**, two sets of three pulleys **226***a,b,c* and **227***a,b,c*, triple pulley mount **230** and cable mount bracket **225**. Bottom end of the stationary arm **222** is attached to the base plate **221** with the top end pivotally connected with first end of the movable arm **223**. Second end of the movable arm **223** is shaped and sized to accommodate three pulleys **226***a,b,c*. Gas spring cylinder **229** is pivotally attached through the fork bracket **228** to the mid section of the movable arm **223** at the top end and to base plate **221** via base bracket **224**. Triple pulley mount **230** with pulleys **227***a,b,c* is mounted to base plate **221** at the far end from stationary arm **222**. Cable **142** is attached to base plate **221** via base bracket **224** passing over and engaging pulleys **226***c*, **227***c*, **226***b*, **227***b*, **226***a*, **227***a*, respectively, and exits and passes over transfer pulleys **153**, **154** and terminates at the cable anchor **155** of pulley mount **88**. Pulley mount **88** illustrates positions of carriage and arm assembly **80** and is interconnected via cable **142**, transfer pulleys **153**, **154** pulleys **227***a,b,c* and **226***a,b,c* via movable arm **223** with gas spring cylinder **229**. Because of the pulley ratio of five to one (5:1), for every inch of travel of gas spring cylinder **229**, carriage and arm assembly **80** illustrated by pulley mount **88** will travel respectively five inches. Also, resistance created by the gas spring cylinder **229**, pulleys **226***a,b,c*, **227***a,b,c* and movable arm **223** equalizes resistance of the moving carriage and arm assembly **80**. Other devices may also include winch type mechanisms (mechanical, electrical with cord or rechargeable batteries as a source of power), mechanical springs and pulleys, and commercially available spring balancers, elastic bands and elastic bands with pulleys, electric servo motors and remotely controlled electric motors with brakes.

The present invention can be adjusted to many different positions to perform a variety of exercises. Referring now to FIG. **1**, **2**, **8**, **9**. To select desired width for exercise, arms **100***a*, **100***b* can be rotated about axes A**1** and A**2** and locked in a pre-selected position. In order to rotate the arms **100***a* and **100***b* to different positions, the exerciser removes pins **108***a*, **108***b* from apertures **85** in selector plate **89**. With pin **108***a* withdrawn from apertures **85** in selector plate **89**, arm **100***a* is free to rotate about axis A**1** over an arc of approximately 180 degrees and can be locked in one of the series of pre-selected positions based on increments defined by the apertures **85**. In the present invention increments of 22.5 degrees are used but any other practical spacing can be used. Arm **100***b* can be adjusted the same way like arm **100***a* described above. Each of the arms **100***a* and **100***b* can be rotated about axis A**1** and A**2** and locked in a selected position irrespectively from each other and regardless of their width and position of the carriage and arm assembly **80** on the vertical post **40** without changing the tension in cable **141**.

After pre-selecting the width of the arms **100***a*, **100***b* the exerciser can adjust the carriage and arm assembly **80** to a proper height for the exercise. To change the vertical (height) position of the carriage and arm assembly **80**, exerciser has to remove carriage selector pin **95** from the apertures **41** in vertical post **40** which can be accomplished by manipulating handle **96** connected via linkage **97** with carriage selector pin **95**. With carriage selector pin **95** disengaged from apertures **41**, carriage and arm assembly **80** is free to move up or down along vertical post **40** engaging rollers **82***a*, **82***b*, **82***c*.

Described above 3 point arm adjustment method is very effective in creating new positions for exercise. As it can be seen, different height positions of the carriage and arm assembly **80** combined with different configurations of the adjustable arms **100***a*, **100***b* provide multiple widths for low and high pulley exercises as well as multiple heights for narrow and wide grip exercises. As it should be noted, prior art machines would require adjustments at four locations (points) to achieve a similar number of positions available for exercise.

One point height adjustment for carriage and arm assembly **80** with unchanged configuration of arms **100***a*, **100***b* greatly shortens transition time between exercises and can simplify more complex workout routines, such as circuit training. With one point height adjustment, exerciser can switch in seconds from low to mid or even high pulley exercises which with prior art, equipment would require at least two separate adjustments. As it can be seen in FIG. **8**, **9**, all starting positions for exercise lie in one plane P (Indicated by straight vertical line in FIG. **9**). This arrangement makes all the adjustments for new positions for exercise easily predictable by the exerciser and it greatly simplifies the use of the bench which doesn't need to be moved to fit new arm positions. Ends of arms **100***a*, **100***b* can easily reach settings for high pulley exercises with three adjustment points (at pins **108***a*, **109***b* and handle **96**) placed at one convenient location. High pulley level can be adjusted by each exerciser to meet their individual needs. With the presented adjustment method for creating new positions for exercise, handles **131***a*, **131***b* at the ends of arms **100***a*, **100***b* can be brought within a view inches from the starting position for exercise which allows for greater economical use available for exercise cable length of cable **141** (FIG. **4**). This ability can be used and appreciated in the fields of rehabilitation and physiotherapy where precise positioning, proper form and execution of the path of the exercise is very important.

As it can be seen in FIG. **9**, present invention is always ready (by providing sufficient space in front of the machine) for various lifting or pulling exercises that require pure vertical resistance without additional attachments or changing of the body positions of the exerciser (as seen in some of the prior art machines). As seen, the presented machine offers full range of undisturbed (by bench) functional exercises without sacrificing their proper form.

Present invention also offers wide range of bench exercises. As it can be seen in FIG. **1**, **2**, in order to perform bench exercises, exerciser has to bring swing away workout station **190** from storage position (FIG. **2**) to exercise position (FIG. **1**). Those skilled in the art will understand that the described bench is just an example of a workout station which can be used with the present invention and that the subject of the invention is the method of bringing the workout station to the exercise position (FIG. **1**) and removal of the entire station (not partial) to the storage position (FIG. **2**).

Bench assembly **180** is connected to swing able arm **193** and can be easily moved from storage to workout position by exerciser by rotating entire swing away workout station **190** about pivot point **191** and securing its position by inserting retractable locking pin **196** into stationary lock receiver **195** located at the end of central reinforcement **34**. At this position, exerciser can select proper angle for back support **182** by inserting tilt selector pin **184** into one of the apertures in tilt selector plate **183**. Those skilled in the art will recognize that the shape and size of the swing able arm **193** can be determined by the type of workout station used with the present invention. Bench assembly **180** can be also adjusted closer or farther away from vertical post **40** and carriage and arm assembly **80** for providing exerciser with more options and ability to maintain proper form during exercises. Position of sliding sleeve **188** can be selected and secured with retractably mounted slide selector pin **197** inserted in one of the selector holes (not shown) in swing able arm **193**. Even with bench assembly **180** in workout position most of the adjustments for carriage and arm assembly **80** can be accomplished. Exerciser can also pre-select the configuration of carriage and arm assembly **80** before placing the bench assembly **180** into workout position.

Because of the described previously capability of carriage and arm assembly **80** to adjust for different positions for exercise, exerciser can perform bench exercises using wide to narrow grip options and can simulate incline, decline and flat bench positions by changing the height of carriage and arm assembly **80**. Handle units **130***a*, **130***b* can align themselves with the angle of cable **141** when pulled or pushed by the exerciser, which gives more exercise options for the exerciser. Because handle units **130***a*, **130***b* rotate in one plane P (FIG. **8**, **9**), exerciser can easily predict new positions of the arms and don't need to adjust their body positions to the new location of the arms (like it can be seen in some of the prior art machines described before).

Referring to FIG. **1**, **2**, **3***a*. The present invention can also be used for non-weight lifting exercises such as: chin up's, dips, push up's, reverse push up's and abdominals. For these exercises the bench assembly **180** has to be in storage position and bars **201***a*, **201***b* (**201***b* not shown) have to be attached to the arms **100***a*, **100***b*. Exerciser then sets arms **100***a*, **100***b* to a desired width and carriage and arm assembly **80** to a suitable height and can perform a chosen exercise using bars **201***a*, **201***b* (**201***b* not shown) detachable handles **204***a*, **204***b* or other attachments like different lengths of chain with handles, sleeves for hang-down abdominal exercises and detachable bars of different lengths.

In order to do all mentioned exercises with prior art equipment, extra dip, chin up, push up, reverse push up and abdominal stations are usually added to the side or back of the machine taking more space and making the machine more costly to build. Prior art equipment lacks the adjustability required for different exerciser size and the level of intensity of the exercise cannot be changed. Present invention overcomes shortcomings of the prior art by using adjustability of the carriage and arm assembly **80** without adding extra stations. This design saves space by attaching bars **201***a*, **201***b* (**201***b* not shown) to arms **100***a*, **100***b* and using the adjustability of the carriage and arm assembly **80** to create different positions for exercises instead of adding extra stations which always add to the cost and space requirement of the machine. Simple adjustments of the carriage and arm assembly **80** allow the exerciser to set the machine to better fit their size and fitness level. Users can easily adjust the machine to their size and add more variations to their exercises by changing their body position and resistance.

Body weight exercises are very effective but can be challenging for beginners, that's why the ability to change resistance and positions without adding extra stations and increasing the size of the machine is a very useful and is not addressed this way by prior art. For example; to decrease resistance of the dips, the exercisers can lower the position of the carriage and arm assembly **80** and put their feet flat on the floor and to increase resistance carriage and arm assembly **80** can be positioned higher. To increase the resistance of the push up and reverse push up, bars **201***a*, **201***b* (**201***b* not shown) can be lowered by lowering carriage and arm assembly **80**, to decrease resistance of the push up and reverse push up bars **201***a*, **201***b* (**201***b* not shown) can be raised by adjusting height of carriage and arm assembly **80**.

Adjustability of present invention can be also used with high speed exercises and stretching. High speed exercises are often used for sport specific applications like boxing, martial arts, golf swing, physiotherapy and rehabilitation, or just for low impact toning and shaping exercises. However, the traditional weight stack cannot be used safely in this application because of the generated momentum. The use of the safer ratio (4:1) reduces this problem, but because of the extra weight, it has only practical use in specialized gym equipment. Elastic tubes can be attached to the ends of the arms and used instead. Weight selected at the weight stack should be set to the maximum. All the positions available with the machine can be used with elastic tubes.

Thanks to the ability to change the height of both arms **100***a*, **100***b* at the same time with just one adjustment, present invention can mimic most of the positions provided by professional and specialized cage type stretching machines. The present invention can accommodate users of various sizes with simple adjustments/transformations. Arms **100***a*, **100***b* provide enough support and strength that any desirable position can be chosen by the exerciser for various stretching exercises.

Referring to FIG. **8**, **9** an exercise Plane P is illustrated. Based on the configurations of carriage positions combined with the adjustable arms positions, it is evident that high and low pulley exercises as well as wide and narrow grip exercises are possible with the present arrangement without unnecessarily extending the lengths of arms **100***a*, **100***b*. Therefore, the present invention can be built shorter than typical exercises machines of this nature offering high and low pulley exercises using shorter and stronger arms, thereby offering a more compact, user-friendly, and economical design.

The present invention can be used for many different types of exercises which normally require a number of different fitness machines or devices. It can be used as a functional trainer machine for unrestricted user defined exercises with multi-directional and adjustable resistance. It provides multiple bench exercises including flat, incline and decline positions with narrow or wide grips ranging from any level between a low to high pulley location. It can also be used for non-weight lifting exercises such as chin-ups, pushups, reverse pushups and abdominals, with taking under consideration the size and the fitness level of the exerciser. When exerciser wants to perform high-speed exercises where traditional weight stack or free-weights cannot be used safely because of the generated momentum, elastic tubes can be attached at the end of the arms and used instead. The present invention can be used for various stretching exercises. What should be noted is that the present invention supports multiple functions using just one adjustable structure without increasing required floor space, while most prior art machines build additional structures for each application increasing the overall size and cost.

Alternative Embodiments

Machine can be built with two weight stacks (sources of resistance). It can be done by splitting cable **141** in half, eliminating pulley **173** connecting available ends of the cable with two sources of resistance.

It can be built with different configuration of pulleys with different load ratios. Pulleys can be positioned at different angles and at different locations as long as the cable compensation is maintained and changes of the angular arm positions **100***a*, **100***b* and adjustments (up or down) of the carriage and arm assembly **80** don't change the tension in cable **141** (or split cable **141**) when two sources of resistance are used. Connection at the source of resistance always terminates at the same location before and after exercise. Load ratios can be changed by adding or removing pulleys and changing the length of the cable. Science of pulleys has been known for thousands of years and mechanical engineering books provide adequate information on how to build various pulley trains with different load ratios.

Angle of arms **100***a*, **100***b* can be changed by either changing the angle between arm and axis A**1**, A**2**, or changing the angle of axis A**1**, A**2** from the horizontal position.

Handle units **130***a*, **130***b* can be built with just one pulley.

Vertical post **40** can also be built in any other practical position other than the vertical position. Also, additional vertical posts, guide posts or any other practical posts may be added for stability, strength and overall reinforcement.

Additional/different locking mechanisms can be used to secure carriage and arm assembly **80**. These mechanisms can include; cam locks, screw in locking pins, push button with electric brake, compression pads, screw or cam activate and others.

Numbers of rollers guiding carriage and arm assembly **80** on vertical post **40** can be different than the three used in the present invention. Also an additional guide post can be placed behind vertical post **40** and guide rollers can run on the inside surfaces between the two posts.

Rollers **82***a*, **82***b*, **82***c* and vertical post **40** can be of different shape and different profile for better and more stable rolling action. Also different devices can be used for guiding like; sleeve bearings, guide bushings, linear bearings and others.

Counterbalance assembly **150** can be operated with remote control electric motor.

Arms **100***a*, **100***b* can have additional anchoring points for attaching resistance bands. They can be located at bearing sleeve **211***a*, **211***b* and at any suitable location on the carriage and arm assembly **80**.

Other multifunctional benches and exercise stations may be adopted and designed to work with the present invention.

Machine can be designed and built without a multifunctional bench and dip bars.

Different materials, sizes and interconnections can be used for all components.

Machine can be built so that the axis of rotation A**1**, A**2** are not parallel to each other.

Machine can be built in a 'light duty version' for lighter loads. Different lighter materials like aluminum or plastics can be used to build carriage and arm assembly **80**. Machine like this can work without counter balance assembly **150**.

What is claimed is:

1. A three-point adjustment multipurpose exercise machine, comprising:

a frame having at least one substantially upright post;

said post describing a substantially vertical axis and a forward horizontal axis;

a slidable carriage assembly having means to slide and lock on the upright post along said substantially vertical axis, whereby said carriage assembly describes a first point of adjustment for said machine for height adjustment;

right and left arm assemblies rotatably, adjustably, and independently mounted to said slidable carriage assembly and each said arm assembly having an axis of rotation parallel to the forward horizontal axis, whereby said mounting point of the right arm describes a second point of adjustment for said machine for adjusting the right arm and said mounting point of the left arm describes a third point of adjustment for said machine for adjusting the left arm, each arm assembly having a handle unit;

a resistance assembly; and

at least one cable coupling the handle units, arm assemblies and the resistance assembly,

whereby the height and the horizontal span of the arm assemblies can be adjusted by said three points of adjustments, through sliding the carriage assembly along the upright post and by pivotably engaging the arm assemblies with the carriage assembly; and

wherein:

a. said carriage assembly comprises an arm selector plate having a right side and a left side;

b. said right arm assembly having a first end and a second end;

c. said left arm assembly having a first end and a second end;

d. the first end of said right arm assembly pivotably, adjustably, and releasably attached to the right side of said arm selector plate and extending rightward, and the first end of the left arm assembly pivotably, adjustably and releasably attached to the left side of said arm selector plate and extending leftward;

e. each said handle unit positioned at the respective second ends of each arm assembly;

f. said at least one cable extending from the right handle unit through the right arm assembly to said resistance assembly and then from said resistance assembly through the left arm assembly and to the left handle unit; and

g. a pulley assembly to guide said cable,

where said three points of adjustments are locked on the arm selector plate in close proximity of each other, based on which the height and the horizontal span of the arms can be adjusted.

2. The three-point adjustment multipurpose exercise machine of claim **1**, wherein said means to slide the slidable carriage assembly is comprised of rollers, and bolts.

3. The three-point adjustment multipurpose exercise machine of claim **1**, wherein said means to lock the slidable carriage assembly on the upright post is comprised of a spring loaded pin.

4. The three-point adjustment multipurpose exercise machine of claim **1**, wherein said carriage assembly comprises:

a. a sleeve having a central opening to receive the upright post where said sleeve has a multiplicity of rollers in its central opening, said rollers positioned and sized to provide for rolling operation of said carriage over the upright post; and wherein

b. said sleeve and rollers are operatively connected via bolts; and wherein

c. said arm selector plate has right and a left semicircular ends and is attached to said sleeve and each said semicircular end having a central aperture, whereby normals to the arm selector plate at the right and left central apertures define a right arm axis and a left arm axis, respectively, and whereby said right and left arm axes provide mounting and rotation points for the right and the left arm assemblies about said respective arm axis;

d. each said semicircle end having multiplicity of position apertures near its perimeter;

e. a pulley mount connected to said sleeve having a horizontal plate, said plate having a right side and a left side;

f. cable anchors mounted on the top and bottom of the pulley mount; and

g. multiplicity of pulleys attached to said pulley mount and said first and second ends of said arm assemblies arranged to keep the tension in the cable constant during the rotation of the arm assemblies about the right and left arm axes,

whereby said carriage and arm assemblies can be adjusted and locked in different heights along the upright post.

5. The three-point adjustment multipurpose exercise machine of claim **4**, wherein said right and left arm assemblies are pivotably connected to the carriage assembly about the right and left arm axes, respectively, and having means to secure the pivotal connection and means to enable adjustment of a rotational resistance.

6. The three-point adjustment multipurpose exercise machine of claim **5**, wherein said arms extend forward at an angle from a pivot attachment point located on the carriage and arm assembly, whereby the arms are angled to provide enough space for performing standing or seated exercises when a pure vertical resistance is required to deliver proper exercise.

7. The three-point adjustment multipurpose exercise machine of claim **6**, wherein the first ends of each said arm assembly comprises:

a. an arm mounting bracket having a front and a rear support;

b. said front and rear supports having position apertures, said apertures having a center;

c. a pulley rotatably mounted between said front and rear supports;

d. arm reinforcement means;

e. a bracket with spring loaded arm selector pin; and

f. said spring loaded arm selector pin mounted in the midsection of the bracket and configured such that in its extended position can be received in one of the position apertures and in the openings of a front reinforcement.

8. The three-point adjustment multipurpose exercise machine of claim **1**, wherein the second ends of each said arm assembly having means to guide said cable through the arms and means to provide cable engagement exercise.

9. The three-point adjustment multipurpose exercise machine of claim **1**, wherein the second ends of each of said arm assemblies each further comprises:

a. an arm pulley assembly comprising a bearing sleeve with a pulley housing, rotatably mounted over a hollow shaft having an end attached to the arm, such that it is free to rotate relative to the arm about a longitudinal axis of the arm;

b. at least one bearing having an outer ring and an inner ring, mounted such that the outer ring is attached to the sleeve and the inner ring is attached to the hollow shaft and secured with external snap rings at the end of the hollow shaft; and

c. at least one pulley rotatably mounted inside said pulley housing, and positioned so that they permit passage of the cable between them, whereby said pulleys are mounted such that their axes of rotation coincides with the axis of the cable when engaged with the pulley,

whereby one pulley is preferably smaller than the other pulley and is positioned such that it engages with the cable when the applied pulling angle of the cable can no longer be supported by one pulley.

10. The three-point adjustment multipurpose exercise machine of claim **1**, wherein a single cable couples both of the handle units with the resistance assembly.

11. The three-point adjustment multipurpose exercise machine of claim **1**, and wherein

the slidable carriage assembly, the left arm assembly, the right arm assembly, and the upright post are configured so that when and as the vertical height of the slidable carriage assembly along the upright post is adjusted, when and as the left arm assembly is rotated with respect to the upright post in a manner that causes at least a portion of the at least one cable to move, and when and as the right arm assembly is rotated with respect to the upright post in a manner that causes at least a portion of the at least one cable to move, the left handle unit and the right handle unit remain in a plane which is substantially parallel to and a distance away from the upright post and the tension in the at least one cable remains substantially the same.

12. A three-point adjustment multipurpose exercise machine, comprising:

a frame having at least one substantially upright post;

said post describing a substantially vertical axis and a forward horizontal axis;

a slidable carriage assembly having means to slide and lock on the upright post along said substantially vertical axis, whereby said carriage assembly describes a first point of adjustment for said machine for height adjustment;

right and left arm assemblies rotatably, adjustably, and independently mounted to said slidable carriage assembly and each said arm assembly having an axis of rotation parallel to the forward horizontal axis, whereby said mounting point of the right arm describes a second point of adjustment for said machine for adjusting the right arm and said mounting point of the left arm describes a third point of adjustment for said machine for adjusting the left arm, each arm assembly having a handle unit;

a resistance assembly; and

at least one cable coupling the handle units, arm assemblies and the resistance assembly,

whereby the height and the horizontal span of the arm assemblies can be adjusted by said three points of adjustments, through sliding the carriage assembly along the upright post and by pivotably engaging the arm assemblies with the carriage assembly; and

wherein:

said carriage assembly comprises an arm selector plate having a right side and a left side;

said right arm assembly having a first end and a second end;

said left arm assembly having a first end and a second end;

the first end of said right arm assembly pivotably, adjustably, and releasably attached to the right side of said arm selector plate and extending rightward, and the first end of the left arm assembly pivotably, adjustably and releasably attached to the left side of said arm selector plate and extending leftward;

each said handle unit positioned at the respective second ends of each arm assembly;

said at least one cable extending from the right handle unit through the right arm assembly to said resistance assembly and then from said resistance assembly through the left arm assembly and to the left handle unit; and

a pulley assembly to guide said cable,

where said three points of adjustments are locked on the arm selector plate in close proximity of each other, based on which the height and the horizontal span of the arms can be adjusted, and

wherein

the three-point adjustment multipurpose exercise machine has removable chin-up and dip bar assemblies attached to the arm assemblies comprising a bar and a sleeve removably attached to the arm assemblies and extending substantially horizontally, whereby, said chin-up and dip bar assemblies bars having means to removably attach to the arm assemblies, and said chin-up and dip bar assemblies are adjusted to various widths by rotating said arm assemblies about right and left axes and securing to the selector plate, and whereby the height of said chin-up and dip bar assemblies can also be adjusted by changing the height of the slidable carriage assembly and the arm assemblies.

13. The three-point adjustable multipurpose exercise machine of claim **12**, wherein said chin-up and dip bar assemblies further comprising handle straps and other attachments attached to a rotatable connection at the end of said chin-up and dip bar assemblies to provide for more exercise options, whereby the intensity of the exercise can be changed by changing the height or the width of the bar assemblies and attachments and the bar assemblies eliminate the need for specially designated chin-up or dip stations which are achieved here without changing the size of the machine and using the same adjustable structure for several different applications.

* * * * *

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(54) **EXERCISE DEVICE WITH VIBRATION CAPABILITIES**

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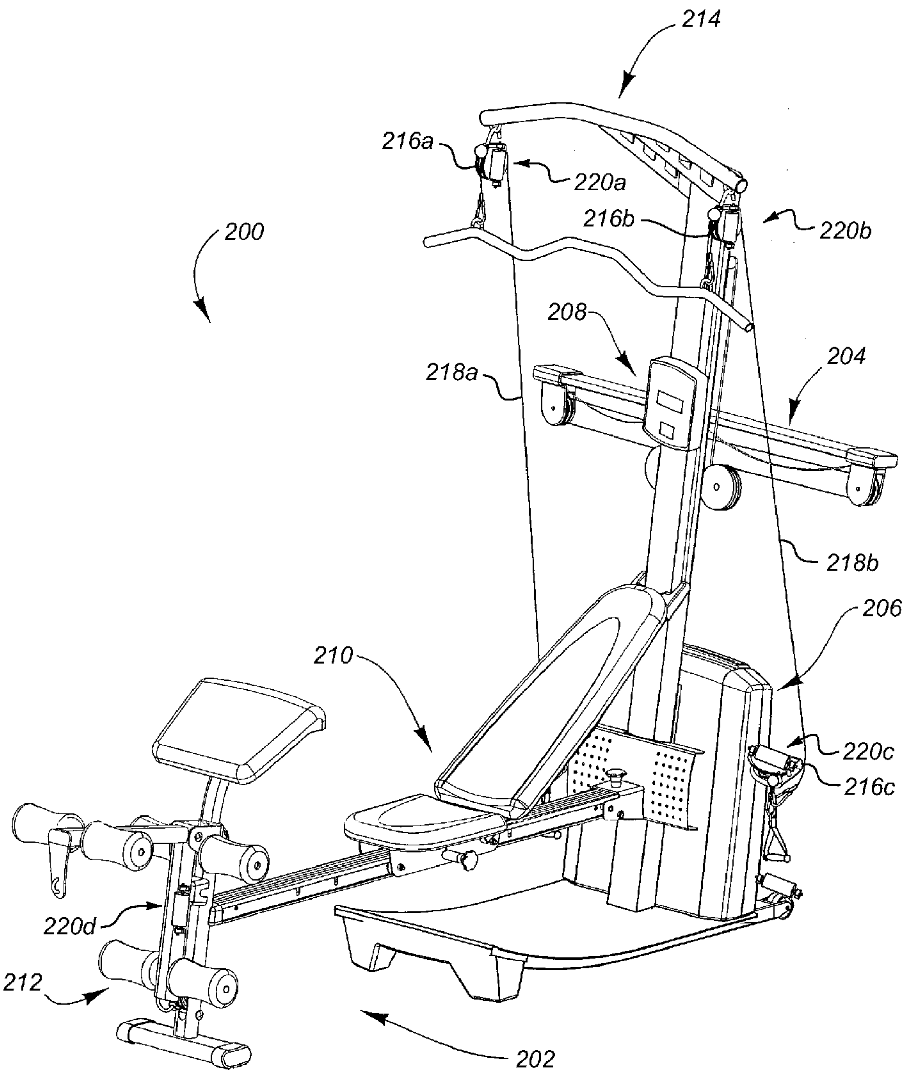
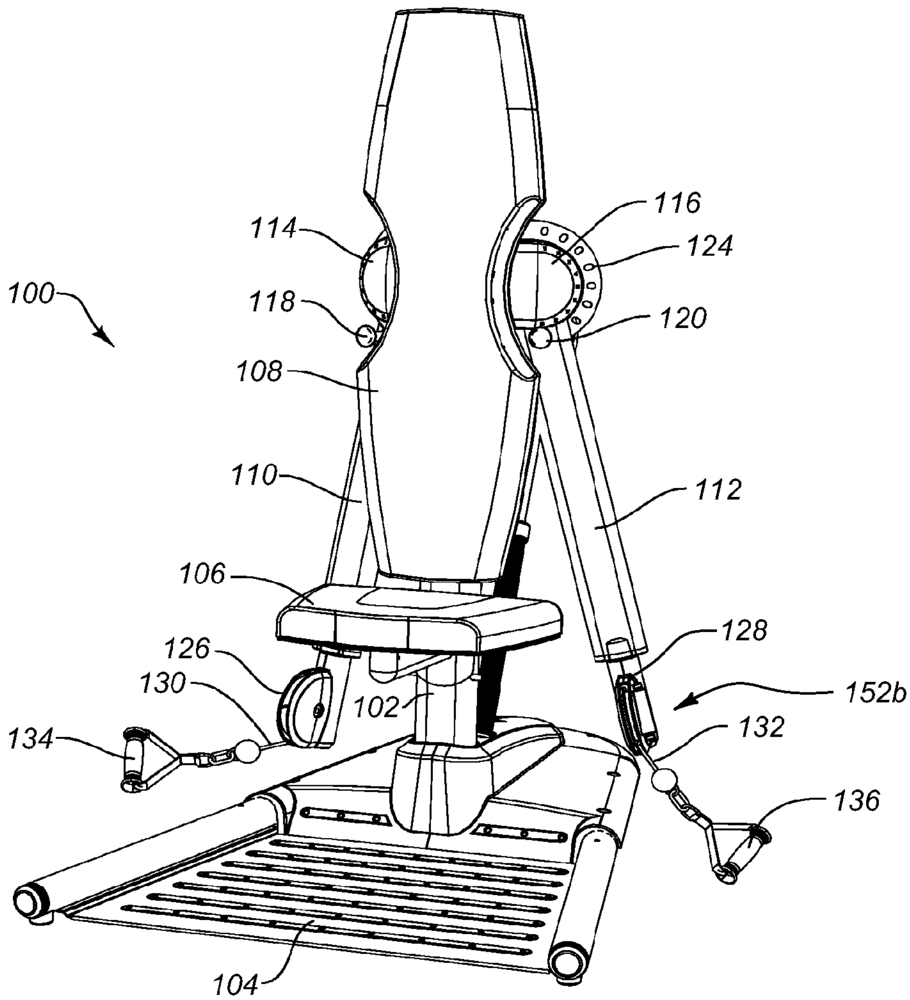
(57) **ABSTRACT**

An exercise device includes a frame having a cable and pulley system connected thereto. The cable and pulley system includes at least one pulley and at least one cable strand. The at least one cable strand has a handle connected thereto for use in performing exercises. One or more vibration assemblies are connected to the at least one pulley in order to vibrate the at least one cable strand. The vibrations from the vibration assemblies are transferred to a user during the performance of exercise to provide various physiological benefits to the user.




116
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104

FIG. 1

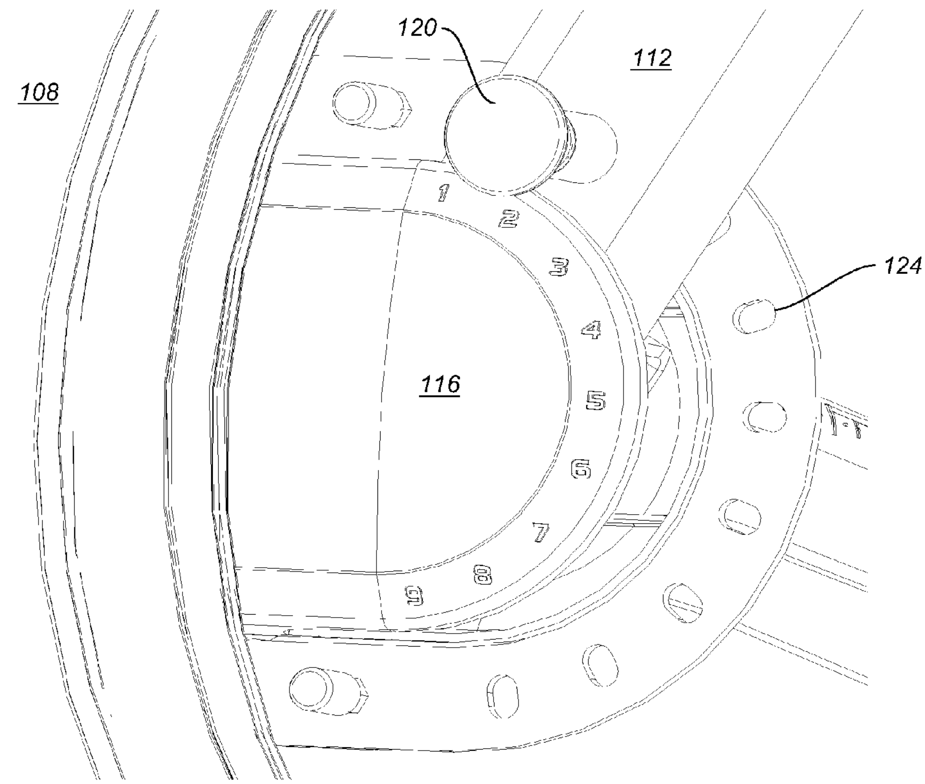

FIG. 2

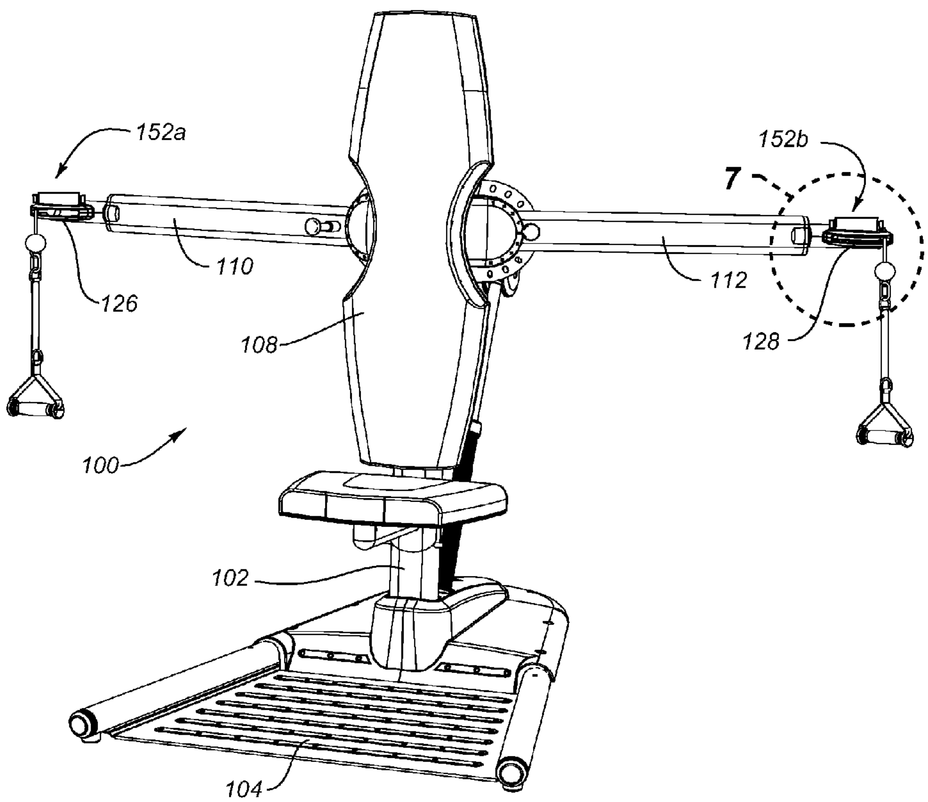

FIG. 3

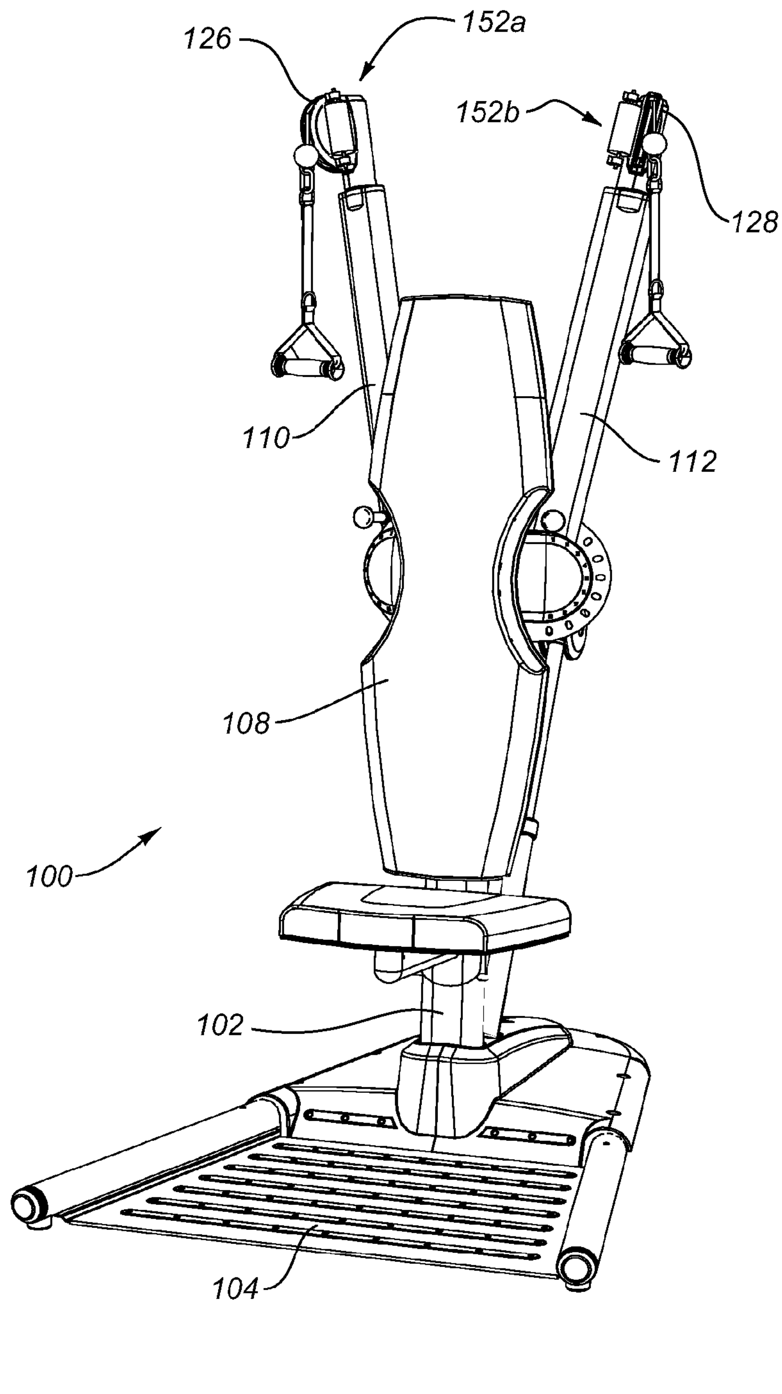

FIG. 4

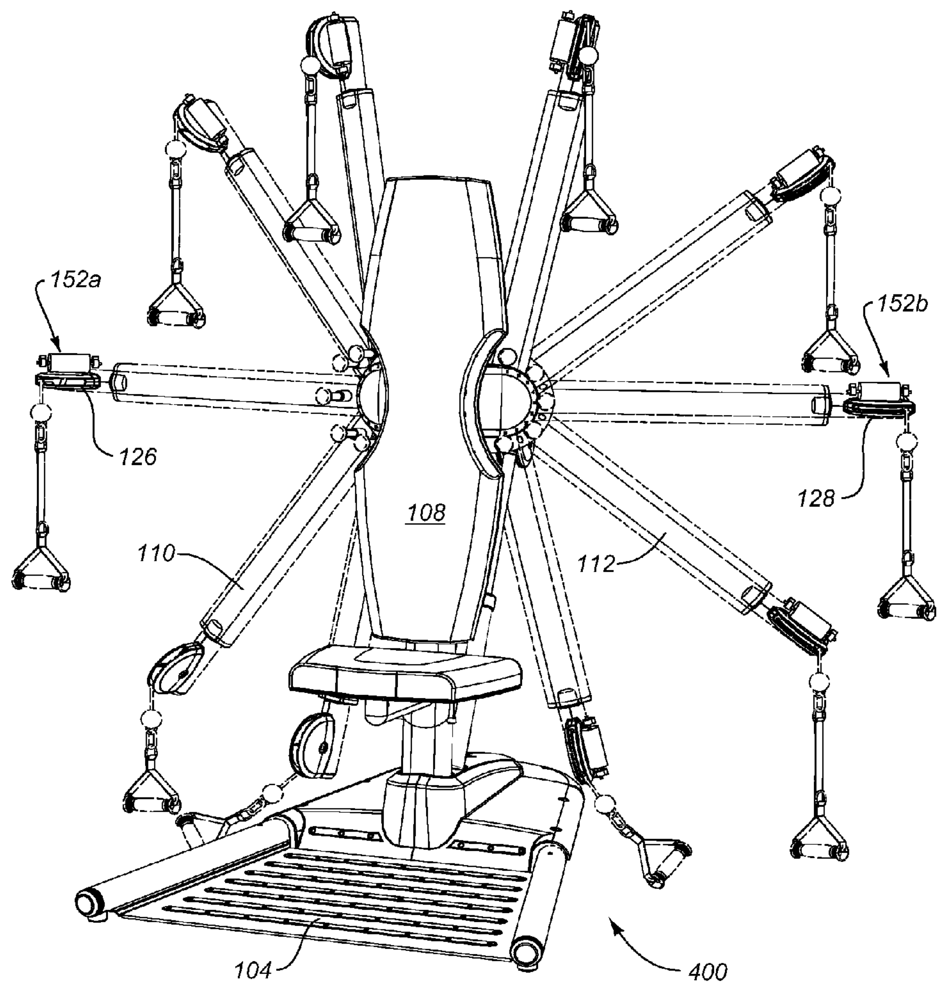

FIG. 5

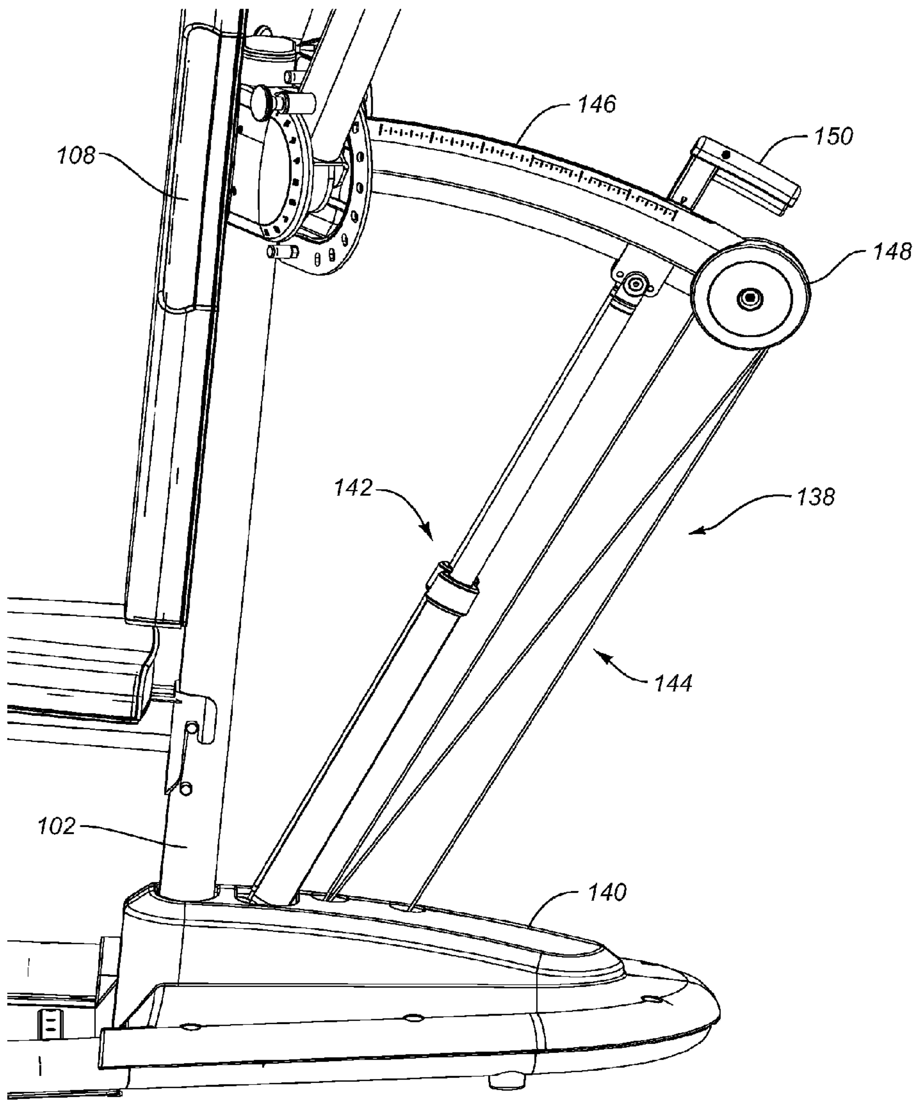

FIG. 6

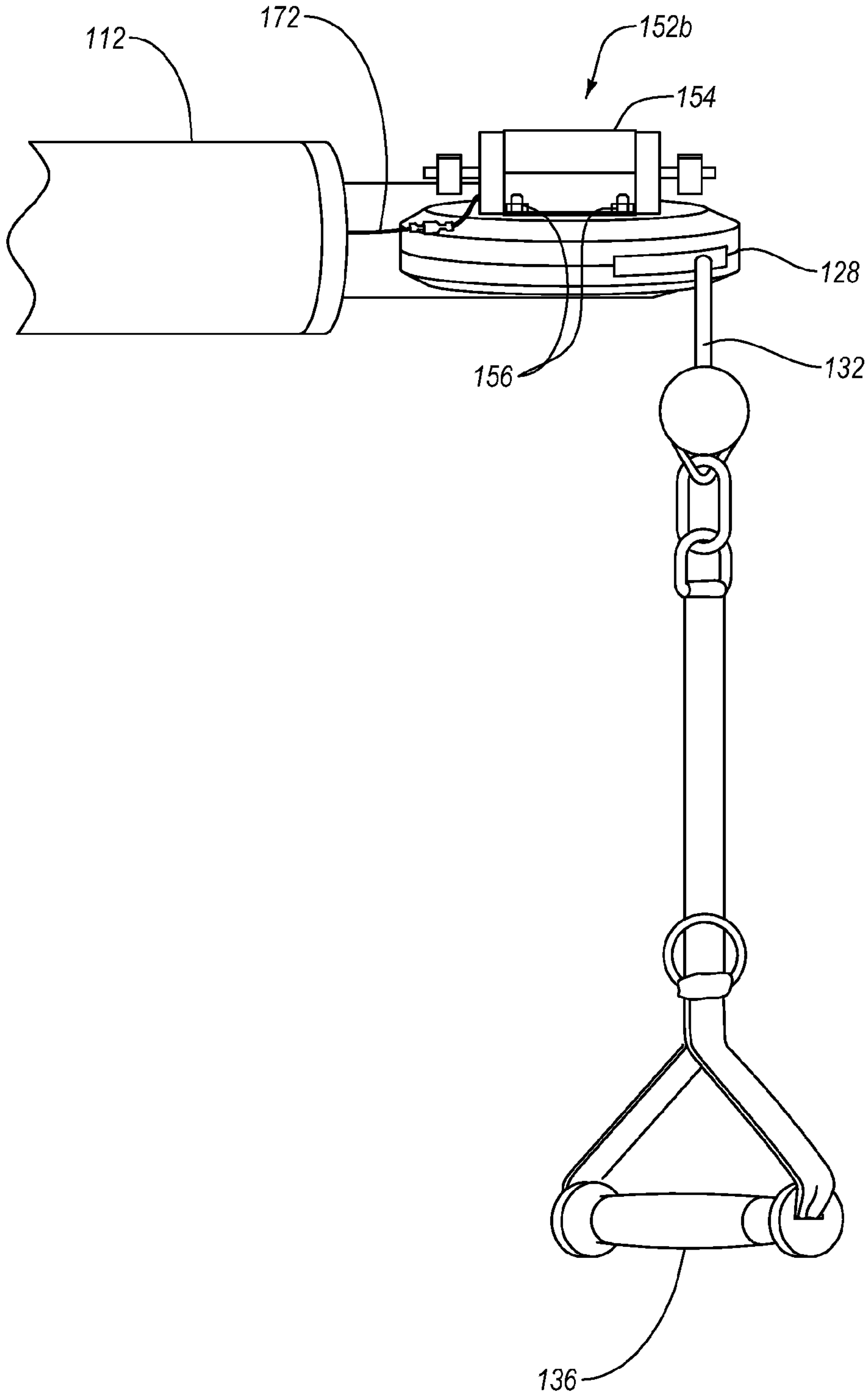

FIG. 7

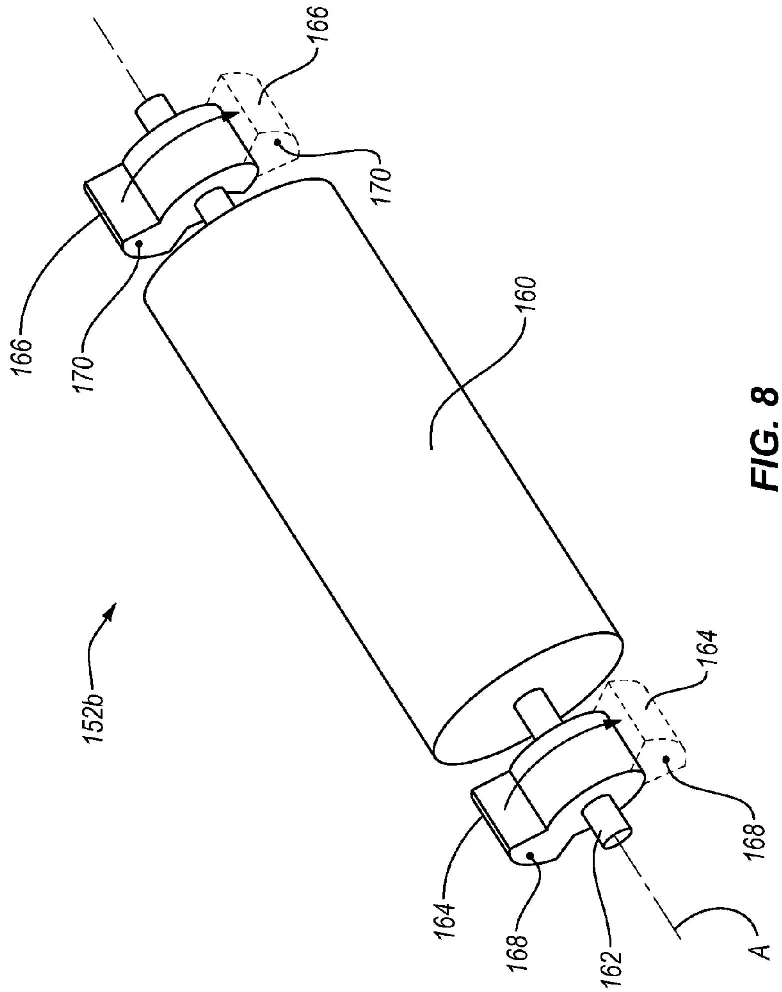

FIG. 8

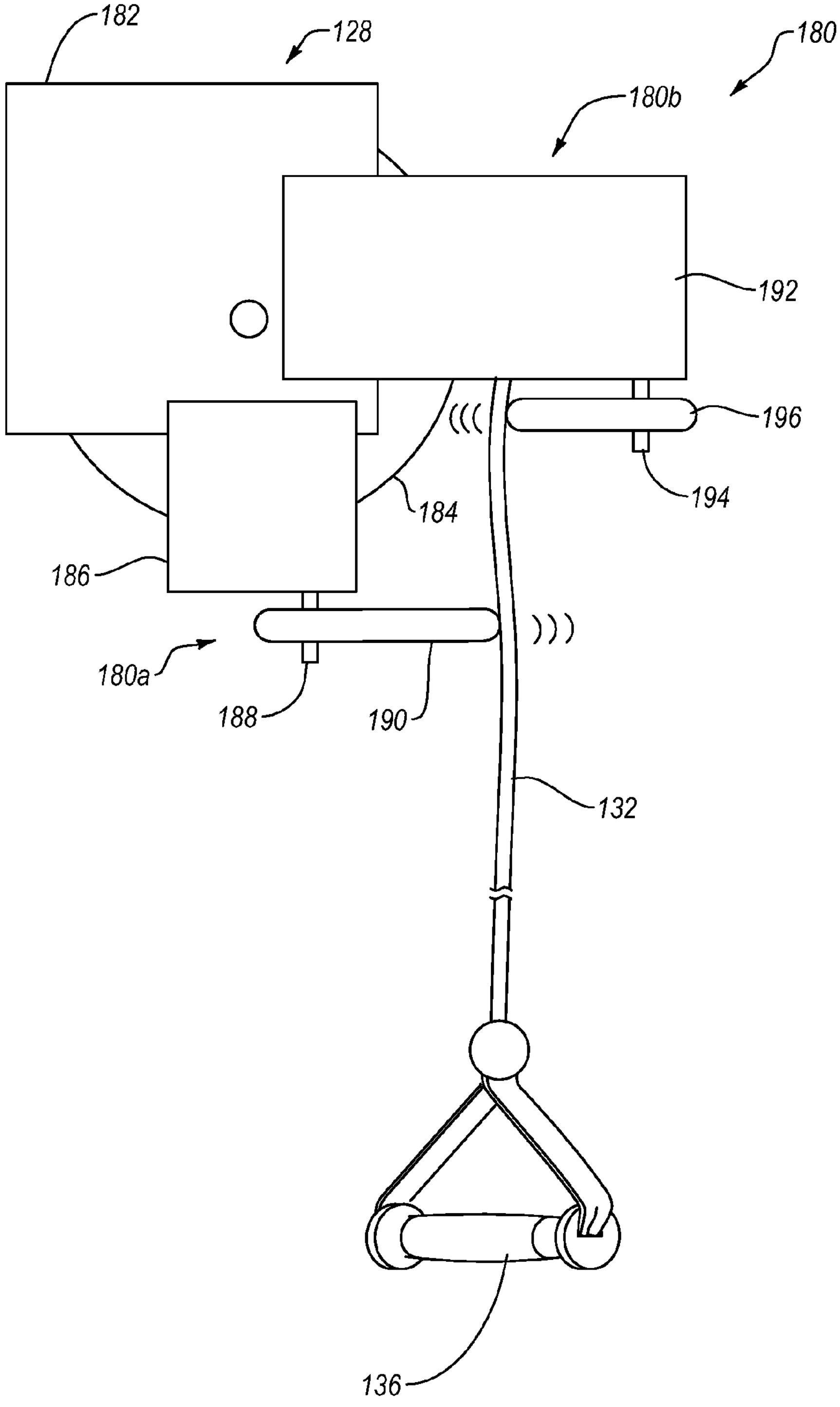

FIG. 9

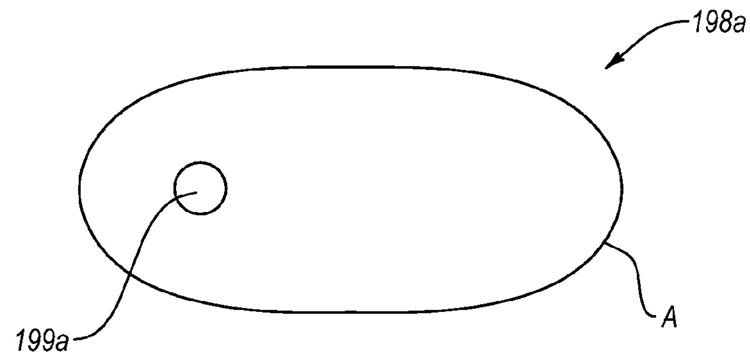

FIG. 10A

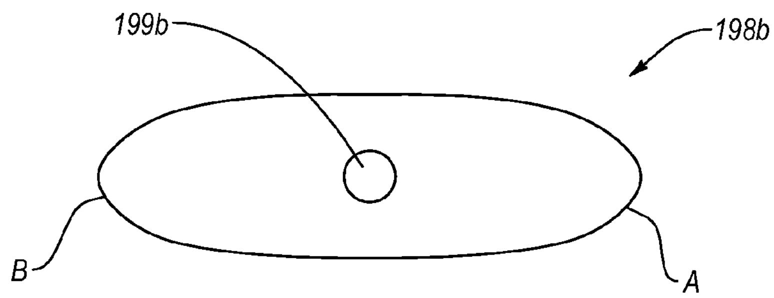

FIG. 10B

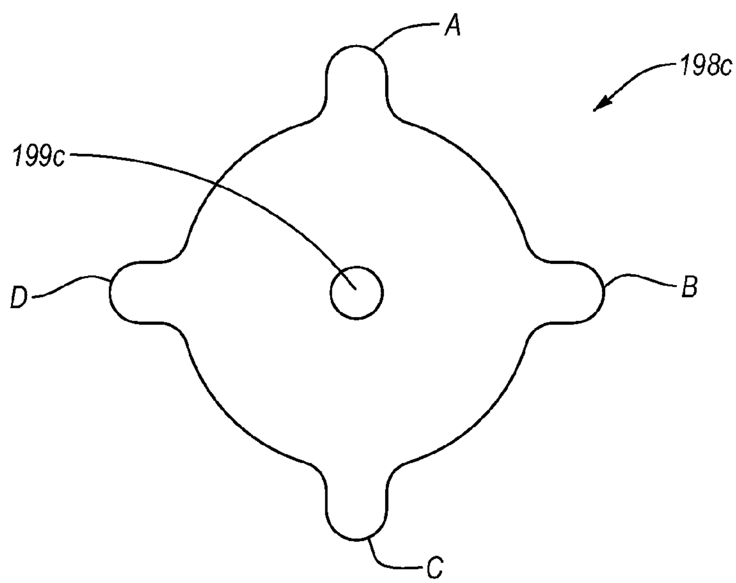

FIG. 10C

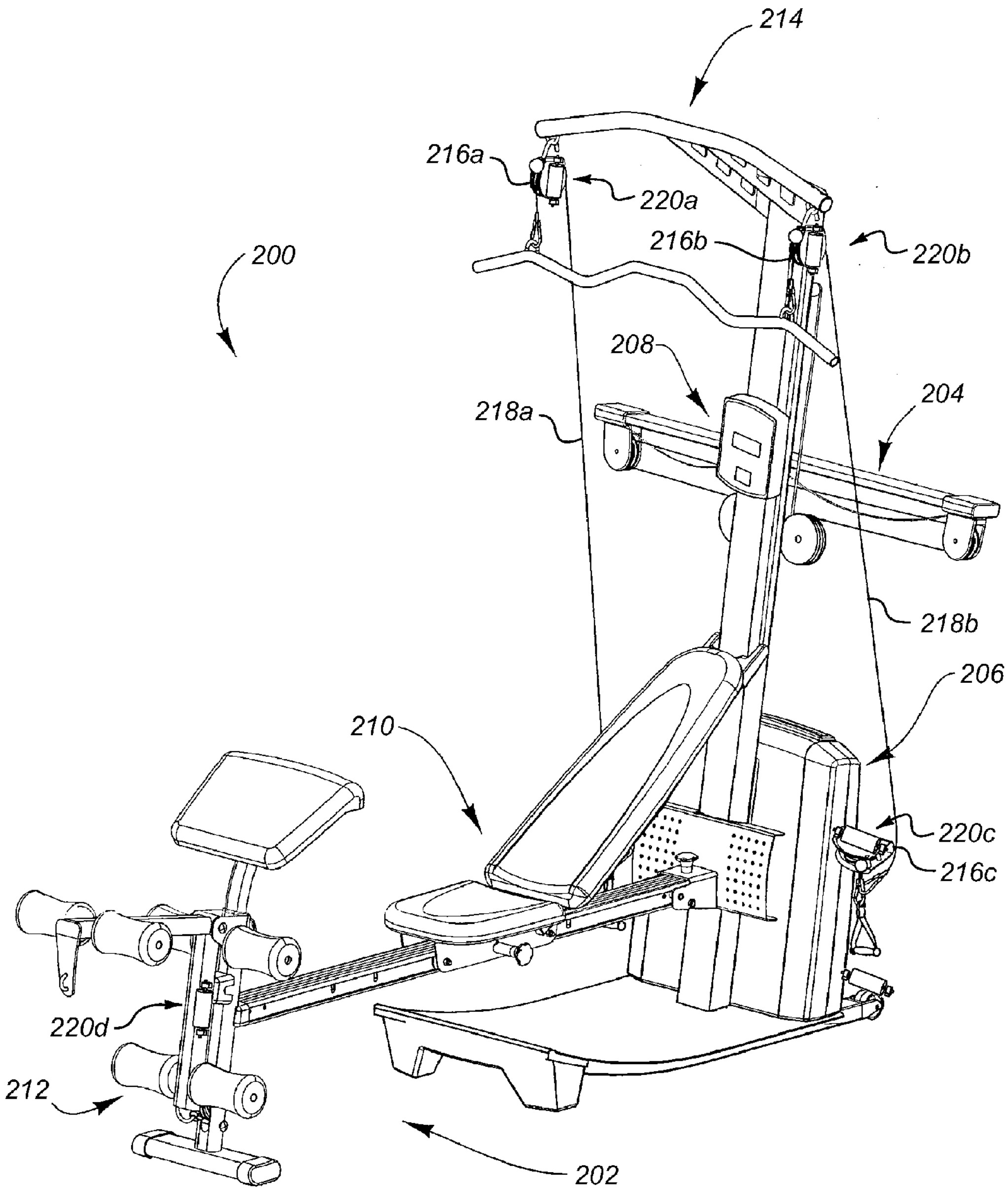
214
216a
220a
216b
220b
200
208
218a
204
218b
206
210
220c
216c
220d
212
202

FIG. 11

EXERCISE DEVICE WITH VIBRATION CAPABILITIES

RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application No. 61/730,301, entitled EXERCISE DEVICE WITH VIBRATION CAPABILITIES, and filed on 27 Nov. 2012, which is incorporated herein in its entirety by this reference.

TECHNICAL FIELD

[0002] This disclosure relates generally to systems, methods, and devices for exercise. More particularly, the disclosure relates to exercise devices with vibration capabilities.

BACKGROUND

[0003] Physical exercise provides exercisers with numerous benefits, including aerobic conditioning, strength enhancement, weight loss, and rehabilitation. These benefits can be realized through various types of exercise, including strength training exercises. Additionally, recent research indicates that vibration therapy can also provide numerous benefits. Such benefits can include improved muscle strength and performance, increased bone density, stamina, flexibility, mobility, and coordination, enhanced critical blood flow throughout the body, relief of aches and pains, enhanced explosive strength, accelerated weight loss, decreased cortisol levels, increased production of serotonin and neurothrophine, and improved injury recovery.

[0004] Various devices have been developed to vibrate a person's body in an effort to realize the above noted benefits of vibration therapy. There have also been efforts made to incorporate vibration into more traditional exercise devices. U.S. Pat. No. 3,205,888, U.S. Pat. No. 4,958,832, U.S. Pat. No. 6,918,859, U.S. Pat. No. 7,166,067, U.S. Pat. No. 7,322,948, U.S. Pat. No. 7,871,355, U.S. Patent Publication No. 2007/0190508, U.S. Patent Publication No. 2008/0207407, U.S. Patent Publication No. 2008/0214971, U.S. Patent Publication No. 2008/0279896, U.S. Patent Publication No. 2009/0118098, U.S. Patent Publication No. 2010/0210418, and U.S. Patent Publication No. 2010/0311552 disclose examples of such vibration exercise devices.

SUMMARY OF THE INVENTION

[0005] In one example embodiment of the disclosure, an exercise device includes a frame, a cable and pulley system linked to the frame, and one or more vibration assemblies. The cable and pulley system includes at least one cable strand and at least one pulley. The at least one cable strand is movable in the performance of an exercise. At least one vibration assembly of the one or more vibrations assemblies is connected to the at least one pulley. The at least one vibration assembly selectively creates vibrations to cause the at least one cable strand to vibrate.

[0006] In another aspect that may be combined with any of the aspects herein, the exercise device also includes a first arm pivotally connected to the frame.

[0007] In another aspect that may be combined with any of the aspects herein, the exercise device also includes a second arm pivotally connected to the frame.

[0008] In another aspect that may be combined with any of the aspects herein, the at least one pulley comprises a first pulley mounted on the first arm and a second pulley mounted on the second arm.

[0009] In another aspect that may be combined with any of the aspects herein, the first pulley and the second pulley each have a cable strand associated therewith from the at least one cable strand.

[0010] In another aspect that may be combined with any of the aspects herein, the one or more vibration assemblies comprise a first vibration assembly connected to the first pulley and second vibration assembly connected to the second pulley to selectively vibrate the cable strands associated with the first pulley and the second pulley.

[0011] In another aspect that may be combined with any of the aspects herein, the first vibration assembly vibrates the first pulley and the second vibration assembly vibrates the second pulley.

[0012] In another aspect that may be combined with any of the aspects herein, the first vibration assembly vibrates the cable strand associated with the first pulley and the second vibration assembly vibrates the cable strand associated with the second pulley.

[0013] In another aspect that may be combined with any of the aspects herein, the first arm and the second arm may each be selectively repositioned between a plurality of positions.

[0014] In another aspect that may be combined with any of the aspects herein, at least one of the one or more vibration assemblies comprises a motor, a shaft rotatable by the motor about an axis of rotation, and one or more eccentric weights mounted on the shaft.

[0015] In another aspect that may be combined with any of the aspects herein, each of the one or more eccentric weights comprises a center of mass that is offset from the axis of rotation.

[0016] In another aspect that may be combined with any of the aspects herein, rotation of the shaft about the axis of rotation causes the centers of mass of the one or more eccentric weights to revolve around the axis of rotation, thereby creating the vibrations.

[0017] In another aspect that may be combined with any of the aspects herein, an intensity or frequency of the vibrations may be selectively controlled by adjusting the speed at which the centers of mass of the one or more eccentric weights revolve around the axis of rotation.

[0018] In another aspect that may be combined with any of the aspects herein, the exercise device also includes a control panel mounted on the frame.

[0019] In another aspect that may be combined with any of the aspects herein, the control panel has one or more user inputs.

[0020] In another aspect that may be combined with any of the aspects herein, the control panel is in electrical communication with the one or more vibration assemblies such that the one or more vibration assemblies are controllable by activating the one or more user inputs.

[0021] In another aspect that may be combined with any of the aspects herein, the exercise device also includes a resistance assembly.

[0022] In another aspect that may be combined with any of the aspects herein, the resistance assembly is adjustable to enable selective adjustment of a level of resistance provided by the resistance assembly.

[0023] In another aspect that may be combined with any of the aspects herein, an intensity or frequency of the vibrations is related to the level of resistance provided by the resistance assembly.

[0024] In another aspect that may be combined with any of the aspects herein, at least one of the one or more vibration assemblies comprises a motor, a shaft rotatable by the motor about an axis of rotation, and one or more cams mounted on the shaft, each of the one or more cams being selectively rotatable to periodically engage the at least one cable strand.

[0025] In another aspect that may be combined with any of the aspects herein, the exercise device also includes at least one of a seat, a backrest, and a bench.

[0026] In another aspect that may be combined with any of the aspects herein, a first arm is pivotally connected to the frame.

[0027] In another aspect that may be combined with any of the aspects herein, the first arm has a first pulley mounted thereon and a first cable strand associated therewith.

[0028] In another aspect that may be combined with any of the aspects herein, a second arm pivotally connected to the frame.

[0029] In another aspect that may be combined with any of the aspects herein, the second arm having a second pulley mounted thereon and a second cable strand associated therewith.

[0030] In another aspect that may be combined with any of the aspects herein, a resistance assembly is connected to the first and second cable strands.

[0031] In another aspect that may be combined with any of the aspects herein, one or more vibration assemblies selectively create vibrations to cause at least one of the first pulley and the second pulley to vibrate.

[0032] In another aspect that may be combined with any of the aspects herein, at least one of the one or more vibration assemblies includes a motor; a shaft rotatable by the motor about an axis of rotation; and one or more eccentric weights fixedly mounted on the shaft such that rotation of the shaft causes the one or more eccentric weights to rotate about the axis of rotation, each of the one or more eccentric weights having a center of mass that is radially offset from the axis of rotation.

[0033] In another aspect that may be combined with any of the aspects herein, vibration of the first pulley causes the first cable strand to vibrate and vibration of the second pulley causes the second cable strand to vibrate.

[0034] In another aspect that may be combined with any of the aspects herein, a resistance level of the resistance assembly is selectively adjustable.

[0035] In another aspect that may be combined with any of the aspects herein, an exercise device includes a cable and pulley system linked to the frame.

[0036] In another aspect that may be combined with any of the aspects herein, the cable and pulley system includes at least one cable strand and at least one pulley, the at least one cable strand being movable in the performance of an exercise.

[0037] In another aspect that may be combined with any of the aspects herein, one or more vibration assemblies selectively create vibrations to cause the at least one cable strand to vibrate.

[0038] In another aspect that may be combined with any of the aspects herein, at least one of the one or more vibration assemblies includes: a motor; a shaft rotatable by the motor about an axis of rotation; and one or more cams fixedly mounted on the shaft such that rotation of the shaft causes the one or more cams to rotate about the axis of rotation, wherein rotation of the one or more cams causes the one or more cams to periodically engage the at least one cable strand to vibrate the at least one cable strand.

[0039] In another aspect that may be combined with any of the aspects herein, the one or more vibration assemblies are mounted on the at least one pulley.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040] FIG. **1** illustrates a perspective view of an exercise device according to one example embodiment of the present invention.

[0041] FIG. **2** illustrates an enlarged, cut-away view of the area where an arm connects to a flange on the backrest of the exercise device of FIG. **1**.

[0042] FIG. **3** illustrates a perspective view of the exercise device of FIG. **1** with arms in alternative positions.

[0043] FIG. **4** illustrates a perspective view of the exercise device of FIG. **1** with the arms in other alternative positions.

[0044] FIG. **5** illustrates a perspective view of the exercise device of FIG. **1** depicting the arms in various possible locations for different exercises.

[0045] FIG. **6** illustrates an enlarged view of a resistance assembly of the exercise device of FIG. **1**.

[0046] FIG. **7** illustrates a close up view of a vibration assembly connected to the exercise device of FIG. **1**.

[0047] FIG. **8** illustrates the vibration assembly of FIG. **7** separate from exercise device of FIG. **1**.

[0048] FIG. **9** illustrates a close view of an alternative vibration assembly for use with the exercise device of FIG. **1**.

[0049] FIGS. **10A-10**C illustrate top plan views of example cams that may be used in connection with the vibration assembly of FIG. **9**.

[0050] FIG. **11** illustrates a perspective view of an exercise device according to another example embodiment of the present invention

DETAILED DESCRIPTION

[0051] The present disclosure is directed to systems, methods, and devices for exercise that include vibration capabilities. Depicted in FIGS. **1-7** are representations of one illustrative exercise device **100**, which may incorporate the novel features of the present invention, including various novel devices, functionalities, hardware and software modules, and the like. As shown, exercise device **100** is depicted as a strength machine.

[0052] In the illustrated embodiment, as shown in FIGS. **1-4**, exercise device **100** comprises a frame **102**, a base plate **104**, a seat **106**, a backrest **108**, and arms **110** and **112** that can be rotated and positioned according to the user's wishes for a desired exercise. Each arm **110** and **120** is movably connected to frame **104** by means of respective "shoulders" or flanges **114** and **116** are adjustable by means of respective knobs **118** and **120** that move into and out of holes **122** and **124** located on flanges **114** and **116**, respectively. Arms **110** and **112** further respectively comprise pulleys **126** and **128** attached at their distal ends, cable strands **130** and **132**, and handles **134** and **136** attached to cable strands **130**, **132**, respectively, for performing arm-related exercises.

[0053] FIG. **2** shows an enlarged, cut-away view of the area where arm **112** connects to flange **116** on backrest **103** by means of the adjustment knob **120**, flange **116** and its holes

124. Arm **112** is pivotally connected to flange **116**. When adjustment knob **120** is moved out of one of holes **124**, arm **112** may be selectively pivoted to a desired orientation. Once arm **112** is in the desired orientation, knob **120** may be moved back into one of holes **124** to selectively secure arm **112** in place. Arm **110** connects to flange **114** in the same manner.

[0054] FIG. **3** shows another perspective view of exercise device **100** of FIG. **1**. In FIG. **3**, arms **110** and **112** have been rotated differently from that of FIG. **1** so that they form about a 180 degree angle and are in position for a different exercise. FIG. **4** shows another perspective view of exercise device **100**. In FIG. **4**, arms **110** and **112** have been rotated differently from that of FIGS. **1** and **3** so that they are in position for yet a different exercise. FIG. **5** shows another perspective view of exercise device **100** with various possible locations in which arms **110** and **112** may be rotated and positioned for different exercises.

[0055] FIG. **6** shows an enlarged view of a resistance assembly **138** of exercise device **100** of FIG. **1**, which includes a cut-away side view of the rear area of exercise device **100** where the user can adjust the resistance level on exercise machine **100**. FIG. **6** shows a rear base **140**, frame **102**, backrest **108**, and resistance assembly **138**, which comprises two gas springs **142**, cable strands **144**, resistance arm **146**, a pulley **148**, and an adjustment handle **150**.

[0056] One option for increasing the amount of resistance provided by resistance assembly **138** includes the user squeezing adjustment handle **150** and moving handle **150**, which is connected to gas springs **142**, along adjustment arm **146** and away from backrest **108**, and then releasing handle **150** in the desired position on adjustment arm **146**. To decrease the amount of resistance, the user can squeeze handle **150** and move handle **150** toward backrest **108**, and then release handle in the desired location on adjustment arm **146**. Note that cable strands **144** and cable strands **130** and **132** may be part of the same cable, all interconnected for the performance of exercises. In the illustrated embodiment, for example, strands **144** are connected to cables **130** and **132** through rear base **140** and frame **102**, as shown in FIG. **6**.

[0057] It is understood that resistance assembly **138** may include various types of resistance mechanisms for providing resistance to the performance of exercises. By way of example, in addition or as an alternative to using gas springs, resistance mechanism **138** may include shocks, elastic bands, metallic springs, motors, brakes (e.g., mechanical, frictional, electric, electro-mechanic, magnetic, electromagnetic), weights, and the like.

[0058] Exercise device **100** may also have the capability to vibrate certain portions of exercise device **100**. For instance, exercise device **100** may include one or more vibration assemblies **152** connected thereto and which vibrate one or more parts of exercise device **100**. In the embodiment illustrated in FIGS. **1** and **3-5**, for instance, exercise device **100** includes two vibration assemblies **152**. More specifically, a vibration assembly **152***a* is connected to pulley **126** and a vibration assembly **152***b* is connected to pulley **128**.

[0059] When activated, vibration assemblies **152***a*-**152***b* may cause all or certain portions of exercise device **100** to vibrate. For instance, vibration assembly **152***a* may cause pulley **126** to vibrate, which vibrations may be transferred through cable strand **130** and handle **134** and into a user's right hand and arm. Similarly, vibration assembly **152***b* may cause pulley **128** to vibrate, which vibrations may be transferred through cable strand **132** and handle **136** and into a user's left hand and arm. Accordingly, vibration assemblies **152***a*-**152***b* may vibrate individual parts of exercise device **100**.

[0060] In other embodiments, one or more of vibration assemblies **152** may vibrate specific areas of exercise device **100**. For instance, one or more vibration assemblies **152** may vibrate frame **102** and components connected thereto (e.g., seat **106**, backrest **108**). In other embodiments, one or more vibration assemblies **152** may vibrate arms **110**, **112** and components connected thereto (e.g., pulleys **126**, **128**, handles **130**, **132**). In still other embodiments, one or more vibration assemblies **152** may vibrate the entirety of exercise device **100**. Thus, exercise device **100** may include a vibration assembly that vibrates a specific portion of exercise device **100**, multiple vibration assemblies that vibrate multiple specific portions of exercise device **100**, or one or more vibration assemblies that vibrate all or a substantial portion of exercise device **100**.

[0061] FIGS. **7** and **8** illustrate vibration assembly **152***b* in greater detail. It is understood that vibration assembly **152***a* may be similar or identical to vibration assembly **152***b*. Accordingly, the following discussion of vibration assembly **152***b* is equally applicable to vibration assembly **152***a*. In FIG. **7**, a close up view of vibration assembly **152***b* is shown mounted to pulley **128**. Mounting vibration assembly **152***b* on pulley **128** may maximize the amount of vibration transferred to a user's hand and arm (via cable strand **132** and handle **136**). As can be seen in FIG. **7**, vibration assembly **152***b* is connected to pulley **128** with a bracket **154** and bolts **156**. In FIG. **8**, vibration assembly **152***b* is shown separate from exercise device **100**.

[0062] According to the illustrated embodiment, vibration assembly **152***b* includes a motor **160**, a shaft **162**, and eccentric weights **164**, **166**. Shaft **162** extends through motor **160** such that motor **160** is able to rotate shaft **162** about a longitudinal axis A of shaft **162**. Each of eccentric weights **164**, **166** has a center of mass that is offset from shaft **162** and axis A. For instance, eccentric weights **164**, **166** may have centers of mass **168**, **170**, respectively.

[0063] In the illustrated embodiment, eccentric weights **164**, **166** are fixedly mounted on opposing ends of shaft **162**. As a result, when shaft **162** is rotated by motor **160**, eccentric weights **164**, **166** likewise rotate about axis A. For instance, in FIG. **8**, eccentric weights **164**, **166** are shown in solid lines in a first position. Eccentric weights **164**, **166** are also shown in dashed lines in a second position after eccentric weights **164**, **166** are rotated partially about axis A. As can be seen, as eccentric weights **164**, **166** rotate, centers of mass **168**, **170** revolve about axis of rotation A. The movement of centers of mass **168**, **170** about axis A causes vibration assembly **152***b* to vibrate. Because vibration assembly **152***b* is mounted to pulley **128**, the vibrations from vibration assembly **152***b* are transferred to pulley **128**, thereby causing cable strand **132** and handle **136** to vibrate. Likewise, the vibrations from vibration assembly **152***a* are transferred to the parts of exercise device **100** to which they are attached (e.g., pulley **126**, cable strand **130**, and handle **134**).

[0064] The intensity and frequency of the vibrations are a result of a number of different variables, including the speed at which the eccentric weights **164**, **166** rotate, the distance between axis A and centers of mass **168**, **170**, and the size of eccentric weights **164**, **166**. The intensity and/or frequency of the vibrations can be increased by increasing the rotational speed of eccentric weights **164**, **166**, increasing the distance between axis A and centers of mass **168**, **170**, and/or increasing the size of eccentric weights **164**, **166**. Conversely, the intensity and/or frequency of the vibrations can be decreased by decreasing the rotational speed of eccentric weights **164**, **166**, decreasing the distance between axis A and centers of mass **168**, **170**, and/or decreasing the size of eccentric weights **164**, **166**.

[0065] Vibration assemblies **152***a*-**152***b* may also be connected to a controller and/or a control panel. For instance, as shown in FIG. **7**, vibration assembly **152***b* is connected to a controller and/or a control panel via wires **172**. Connecting vibration assemblies **152***a*-**152***b* to a controller enables the controller to control the operation of vibration assemblies **152***a*-**152***b*, including such things as turning vibration assemblies **152***a*-**152***b* on and off, controlling the speed at which the eccentric weights are rotated, and which direction the eccentric weights are rotated. Similarly, connecting vibration assemblies **152***a*-**152***b* to a control panel enables a user of exercise device **100** to selectively control the operation of vibration assemblies **152***a*-**152***b* at the control panel. For instance, a user may activate one or more inputs on the control panel to turn one or more of vibration assemblies **152***a*-**152***b* on or off, adjust the speed at which the eccentric weights of each vibration assembly are rotated, and/or alter the direction the eccentric weights rotate.

[0066] Turning attention to FIG. **9**, there is illustrated an alternative embodiment of a vibration assembly **180** that may be used in connection with exercise device **100**. As can be seen, vibration assembly **180** includes a first vibration assembly **180***a* and a second vibration assembly **180***b*. Similar to vibration assembly **152***b*, vibration assemblies **180***a*-**180***b* are mounted on pulley **128**.

[0067] Pulley **128** includes a housing **182** and a wheel **184** rotatably mounted therein. Vibration assemblies **180***a*-**180***b* are mounted on or connected to housing **182**. More specifically, vibration assembly **180***a* includes a motor **186** mounted on housing **182**. Extending from motor **186** is a shaft **188** with a cam **190** mounted thereon. Motor **186** is capable of rotating shaft **188**. Rotation of shaft **188** causes cam **190** to likewise rotate. As shaft **188** rotates cam **190**, cam **190** periodically engages cable strand **132**. The periodic engagement of cam **190** and cable strand **132** causes cable strand **132** to vibrate. As discussed above, the vibrations in cable strand **132** can be transferred to a user's hand and arm.

[0068] Similar to vibration assembly **180***a*, vibration assembly **180***b* includes a motor **192** mounted on housing **182**. Extending from motor **192** is a shaft **194** with a cam **196** mounted thereon. Motor **192** is capable of rotating shaft **194**. Rotation of shaft **194** causes cam **196** to likewise rotate. As shaft **194** rotates cam **196**, cam **196** periodically engages cable strand **132**. The periodic engagement of cam **196** and cable strand **132** causes cable strand **132** to vibrate. As discussed above, the vibrations in cable strand **132** can be transferred to a user's hand and arm.

[0069] Various modifications to vibration assembly **180** are contemplated within the scope of the present invention. By way of non-limiting example, vibration assembly **180** may include one or both of vibration assemblies **180***a*, **180***b*. Additionally, each of vibration assemblies **180***a*, **180***b* may include one or more cams that rotate and periodically engage cable strand **132**.

[0070] Cams **190** and **196** may take a variety of forms. FIGS. **10**A-**10**C illustrate top plan views of various examples embodiments of cams that may be used in connection with vibration assembly **180**. For instance, FIG. **10**A illustrates a cam **198***a* that has a generally oval shape. As can be seen, cam **198***a* includes an opening **199***a* through which a shaft (e.g., shaft **188**, **194**) may be received and about which cam **198***a* may rotate. The offset placement of opening **199***a* in cam **198***a* enables end A of cam **198***a* to periodically engage a cable strand as cam **198***a* rotates. As noted, the periodic engagement of the cable strand by cam **198***a* causes the cable strand to vibrate, which vibrations may be transferred to a user's hand and arm through a handle.

[0071] Cam **198***b* shown in FIG. **10**B is also generally oval shaped. In contrast to cam **198***a*, however, cam **198***b* includes an opening **199***b* that is generally centered in cam **198***b*. As a result, ends A and B of cam **198***b* engage a cable strand in an alternating fashion as cam **198***b* is rotated. The periodic engagement of ends A and B with the cable strand causes the cable strand to vibrate, which vibrations may be transferred to a user's hand and arm through a handle.

[0072] FIG. **10**C illustrates yet another embodiment of a cam **198***c*. Cam **198***c* includes an opening **199***c* that is generally centered in cam **198***c*. Cam **198***c* is generally diamond shaped with nubs A, B, C, and D at the vertices. As cam **198***c* is rotated about opening **199***c*, nubs A, B, C, and D engage a cable strand, thereby causing the cable strand to vibrate.

[0073] FIG. **11** illustrates a perspective view of an exercise device **200**. Exercise device **200** is illustrated as an alternative embodiment of a strength machine. Exercise device **200** includes a support frame **202**, a resistance assembly **204**, a variable resistance system **206**, and a weight selector controller **208**. Exercise device **200** also includes a bench **210**, a bicep/quadricep exerciser **212**, and a lat tower **214**. As will be appreciated by those skilled in the art, a variety of types and combinations of components can be utilized with the exercise apparatus without departing from the scope and spirit of the present invention.

[0074] As can be seen, resistance assembly **204** includes a cable and pulley system. More specifically, resistance assembly **204** includes a plurality of pulleys **216***a*-**216***c* and cables strands **218***a*-**218***b*. Like exercise device **100**, exercise device **200** may also include one or more vibration assemblies **220***a*-**220***d* for vibrating one or more parts of exercise device **200**. For instance, as illustrated in FIG. **11**, exercise device **200** includes a vibration assembly **220***a* connected to a first pulley **216***a*, a vibration assembly **220***b* connected to a second pulley **216***b*, a vibration assembly **220***c* connected to a third pulley **216***c*, and a vibration assembly **220***d* connected to bicep/quadricep exerciser **212**. Vibration assemblies **220***a*-**220***d* may selectively one or more of vibration pulleys **216***a*-**216***c* and bicep/quadricep exerciser **212**, which vibrations may be transferred to the user.

INDUSTRIAL APPLICABILITY

[0075] In general, embodiments of the present disclosure relate to systems and devices that impart vibrations to a user's body. More particularly, the systems and devices of the present disclosure impart vibrations to a user's body during the performance of an exercise. The exercise and the imparted vibrations can provide numerous benefits to the user, including aerobic conditioning, improved muscle strength and performance, increased bone density, stamina, flexibility, mobility, and coordination, enhanced critical blood flow throughout the body, relief of aches and pains, enhanced explosive strength, accelerated weight loss, decreased cortisol levels, increased production of serotonin and neurothrophine, and improved injury recovery.

[0076] The systems and devices of the present disclosure may include an exercise device in the form of a strength machine type exercise device. The exercise devices may include a frame and a cable and pulley system that a user engages to perform exercises. The exercise devices may also include resistance mechanisms for varying the level of resistance provided to the performance of the exercises.

[0077] The systems and devices of the present disclosure may also include one or more vibration assemblies that create vibrations that are imparted to the user during the performance of the exercise. Each of the one or more vibration assemblies may include a motor, such as a rotary motor, that rotates a shaft about an axis of rotation. The axis of rotation may be generally parallel to or collinear with a longitudinal axis of the shaft. One or more eccentric weights may be mounted on the shaft such that rotation of the shaft causes the one or more eccentric weights to rotate about the axis of rotation. Each of the one or more eccentric weights may have a center of mass that is offset from the axis of rotation. As a result of the offset between the centers of mass and the axis of rotation, rotation of the one or more eccentric weights creates vibrations that are transferred through the exercise device and into the user. In other embodiments, the vibration assembly motor may directly rotate the one or more eccentric weights without requiring the weights to be mounted on a shaft.

[0078] In addition or as an alternative to using eccentric weights to create the vibrations, the one or more vibration assemblies may include one or more cams that are rotated by the motor. As the cams are rotates, one or more portions of the cam may periodically engage the cable strands from the cable and pulley system, thereby vibrating the cable strand. The vibrations in the cable strands may be transferred to a user via one or more handles connected to the cable strands.

[0079] The one or more vibration assemblies may be connected to the exercise device such that the vibrations created by the one or more vibration assemblies are transferred to specific parts or the entirety of the exercise device. For instance, the one or more vibration assemblies may be rigidly connected to specific locations on the exercise device. Such locations may include on or near one or more of the pulleys, bicep/quadricep exerciser, frames, and handles. Accordingly, one or more vibration assemblies may be connected to the exercise device to vibrate one or more portions of the exercise device. The number of vibration assemblies used may depend on the size of the vibration assemblies used, the placement of the vibration assemblies on the exercise device, and/or the portions of the exercise device that are to be vibrated.

[0080] For instance, one relatively large vibration assembly may be connected to the frame. This arrangement may allow for the vibrations to spread through the frame and into the user by way of the seat or backrest. Alternatively, one or more vibration assemblies may be connected to the pulleys to vibrate the pulleys and/or the cable strands. Similarly, one or more vibration assemblies may be connected to the bicep/quadricep exerciser. Still further, multiple vibration assemblies may be connected to the exercise device at various locations to vibrate one or more portions of the exercise device.

[0081] In cases where multiple vibration assemblies are used, the vibration assemblies may be coordinated with one another to create vibrations with desired characteristics. For instance, the rotational speed and/or direction of the vibration assemblies may be coordinated to create vibrations with desired intensities and/or frequencies. More specifically, the rotational speed and/or direction of each vibration assembly may be controlled to generate the desired vibrations where the user contacts the exercise device. In other words, the rotational speed and/or direction of each vibration assembly may be controlled so that the vibrations from each vibration assembly either add to or partially cancel the vibrations from the other vibration assemblies to achieve the desired vibrations.

[0082] In addition or as an alternative to having rotating eccentric weights that create vibrations, the one or more vibration assemblies may include one or more rotating cams or other movable members that periodically engage, hit, or tap the exercise device or components thereof in order to create the vibrations in the exercise device.

[0083] In some embodiments, the intensity and/or frequency of the vibrations may be tied to other operating parameters of the exercise device. By way of non-limiting example, he intensity and/or frequency of the vibrations may increase or decrease as the resistance level of the resistance mechanism increases or decreases. Similarly, the intensity and/or frequency of the vibrations may be tied to speed at which the user is exercising.

What is claimed is:

1. An exercise device, comprising:

a frame;

a cable and pulley system linked to the frame, the cable and pulley system comprising at least one cable strand and at least one pulley, the at least one cable strand being movable in the performance of an exercise; and

one or more vibration assemblies, at least one vibration assembly of the one or more vibrations assemblies being connected to the at least one pulley, wherein the at least one vibration assembly selectively creates vibrations to cause the at least one cable strand to vibrate.

2. The exercise device of claim **1**, further comprising:

a first arm pivotally connected to the frame; and

a second arm pivotally connected to the frame.

3. The exercise device of claim **2**, wherein the at least one pulley comprises a first pulley mounted on the first arm and a second pulley mounted on the second arm, the first pulley and the second pulley each having a cable strand associated therewith from the at least one cable strand.

4. The exercise device of claim **3**, wherein the one or more vibration assemblies comprise a first vibration assembly connected to the first pulley and second vibration assembly connected to the second pulley to selectively vibrate the cable strands associated with the first pulley and the second pulley.

5. The exercise device of claim **4**, wherein the first vibration assembly vibrates the first pulley and the second vibration assembly vibrates the second pulley.

6. The exercise device of claim **4**, wherein the first vibration assembly vibrates the cable strand associated with the first pulley and the second vibration assembly vibrates the cable strand associated with the second pulley.

7. The exercise device of claim **2**, wherein the first arm and the second arm may each be selectively repositioned between a plurality of positions.

8. The exercise device of claim **1**, wherein at least one of the one or more vibration assemblies comprises a motor, a shaft rotatable by the motor about an axis of rotation, and one or more eccentric weights mounted on the shaft, each of the one or more eccentric weights comprising a center of mass that is offset from the axis of rotation.

9. The exercise device of claim **8**, wherein rotation of the shaft about the axis of rotation causes the centers of mass of the one or more eccentric weights to revolve around the axis of rotation, thereby creating the vibrations.

10. The exercise device of claim **9**, wherein an intensity or frequency of the vibrations may be selectively controlled by adjusting the speed at which the centers of mass of the one or more eccentric weights revolve around the axis of rotation.

11. The exercise device of claim **1**, further comprising a control panel mounted on the frame, the control panel having one or more user inputs, the control panel being in electrical communication with the one or more vibration assemblies such that the one or more vibration assemblies are controllable by activating the one or more user inputs.

12. The exercise device of claim **1**, further comprising a resistance assembly, the resistance assembly being adjustable to enable selective adjustment of a level of resistance provided by the resistance assembly.

13. The exercise device of claim **12**, wherein an intensity or frequency of the vibrations is related to the level of resistance provided by the resistance assembly.

14. The exercise device of claim **1**, wherein at least one of the one or more vibration assemblies comprises a motor, a shaft rotatable by the motor about an axis of rotation, and one or more cams mounted on the shaft, each of the one or more cams being selectively rotatable to periodically engage the at least one cable strand.

15. The exercise device of claim **1**, further comprising at least one of a seat, a backrest, and a bench.

16. An exercise device, comprising:

a frame;

a first arm pivotally connected to the frame, the first arm having a first pulley mounted thereon and a first cable strand associated therewith;

a second arm pivotally connected to the frame, the second arm having a second pulley mounted thereon and a second cable strand associated therewith;

a resistance assembly connected to the first and second cable strands;

one or more vibration assemblies, wherein the one or more vibration assemblies selectively create vibrations to cause at least one of the first pulley and the second pulley to vibrate, at least one of the one or more vibration assemblies comprising:

a motor;

a shaft rotatable by the motor about an axis of rotation; and

one or more eccentric weights fixedly mounted on the shaft such that rotation of the shaft causes the one or more eccentric weights to rotate about the axis of rotation, each of the one or more eccentric weights having a center of mass that is radially offset from the axis of rotation.

17. The exercise cycle of claim **16**, wherein vibration of the first pulley causes the first cable strand to vibrate and vibration of the second pulley causes the second cable strand to vibrate.

18. The exercise cycle of claim **16**, wherein a resistance level of the resistance assembly is selectively adjustable.

19. An exercise device, comprising:

a frame;

a cable and pulley system linked to the frame, the cable and pulley system comprising at least one cable strand and at least one pulley, the at least one cable strand being movable in the performance of an exercise; and

one or more vibration assemblies, wherein the one or more vibration assemblies selectively create vibrations to cause the at least one cable strand to vibrate, at least one of the one or more vibration assemblies comprising:

a motor;

a shaft rotatable by the motor about an axis of rotation; and

one or more cams fixedly mounted on the shaft such that rotation of the shaft causes the one or more cams to rotate about the axis of rotation, wherein rotation of the one or more cams causes the one or more cams to periodically engage the at least one cable strand to vibrate the at least one cable strand.

20. The exercise cycle of claim **16**, wherein the one or more vibration assemblies are mounted on the at least one pulley.

* * * * *

US 20060035755A1

APPENDIX PP

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(54) **ELLIPTICAL EXERCISE MACHINE WITH INTEGRATED ANAEROBIC EXERCISE SYSTEM**

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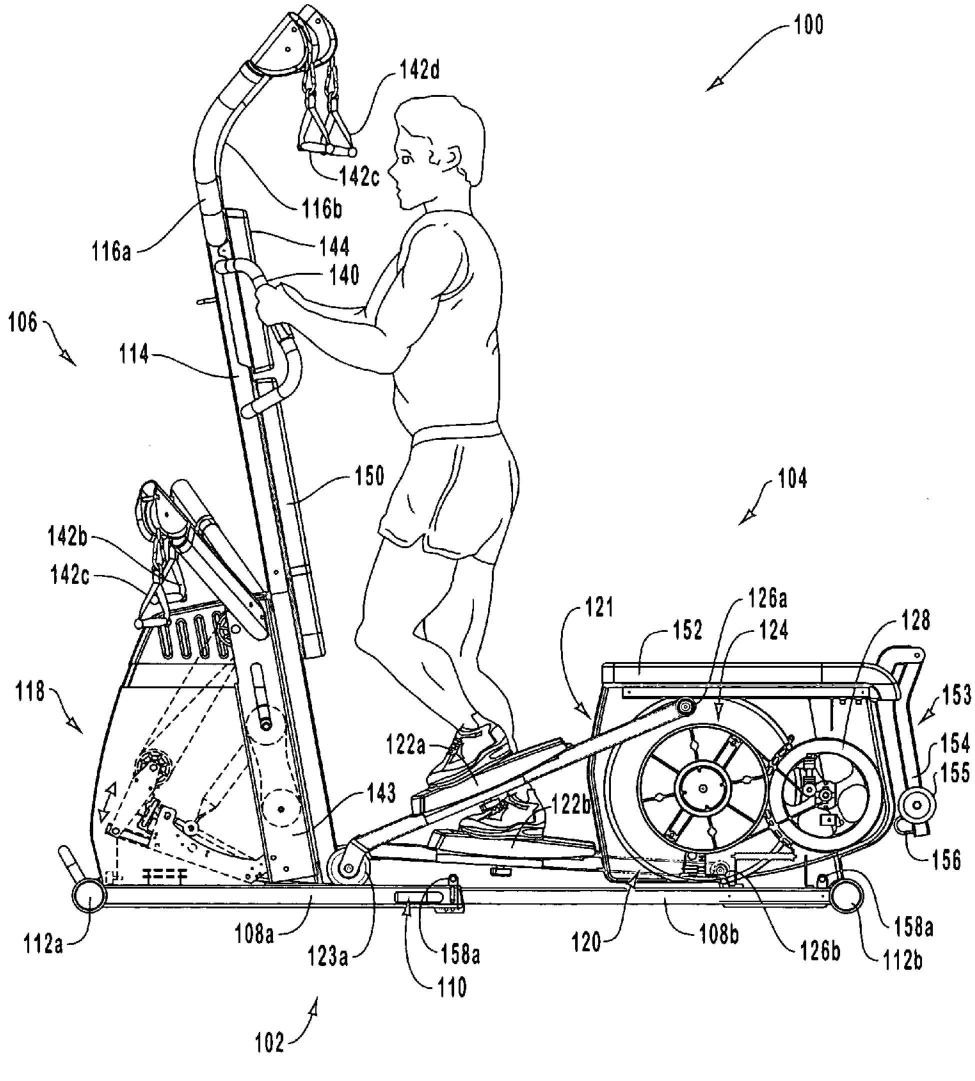
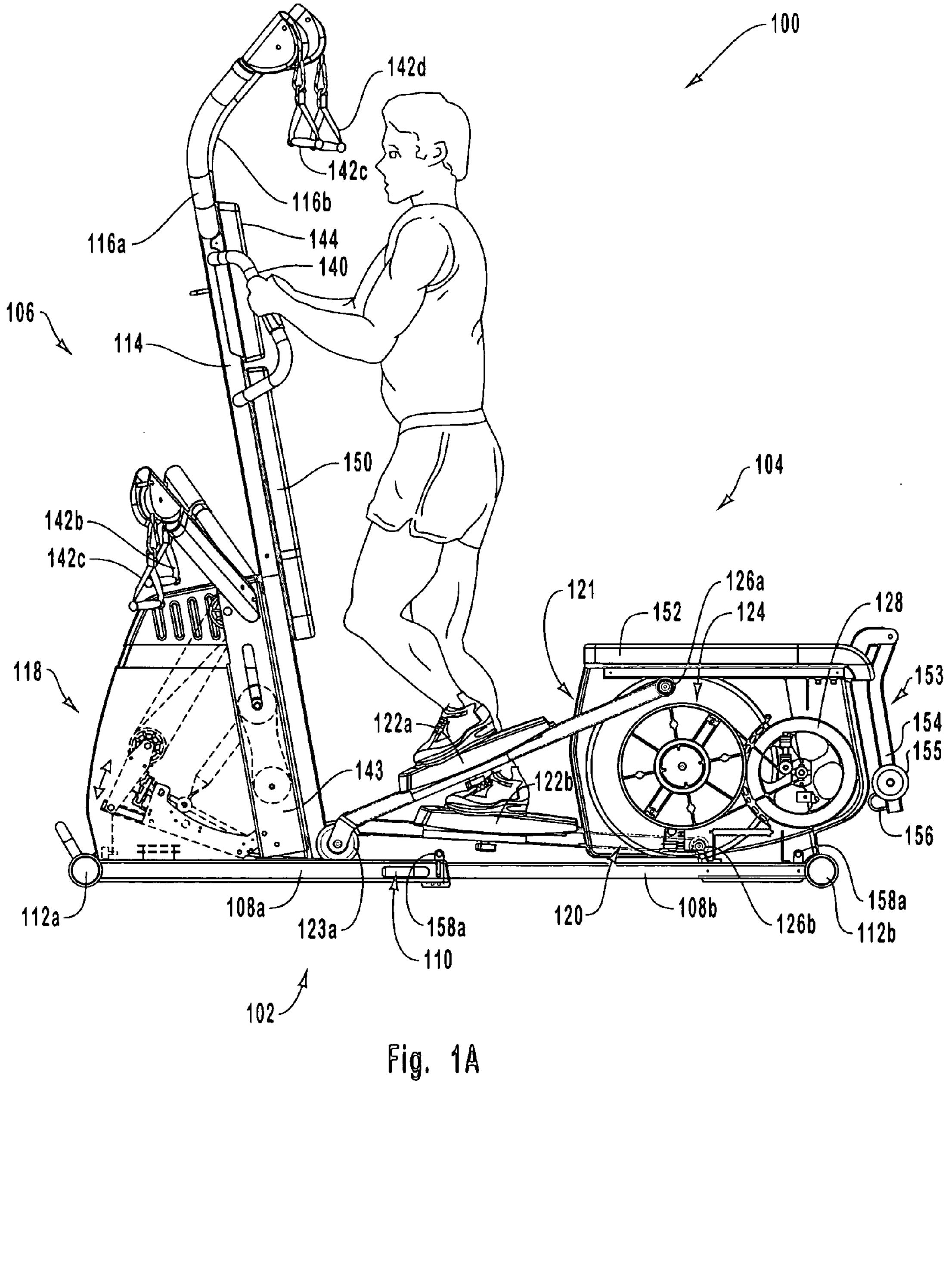
(57) **ABSTRACT**

A combined anaerobic and aerobic exercise system comprises a multi-part frame, for example a telescoping frame, or a pivoting frame. The aerobic system may include an elliptical exercise device, while the anaerobic system may include a cable-based system wherein resistance is adjustable. An electronic console system at the exercise system allows a user to view progress in both anaerobic and aerobic workouts, and to send input signals that adjust anaerobic and aerobic resistance mechanisms.

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158a
112b
102

Fig. 1A

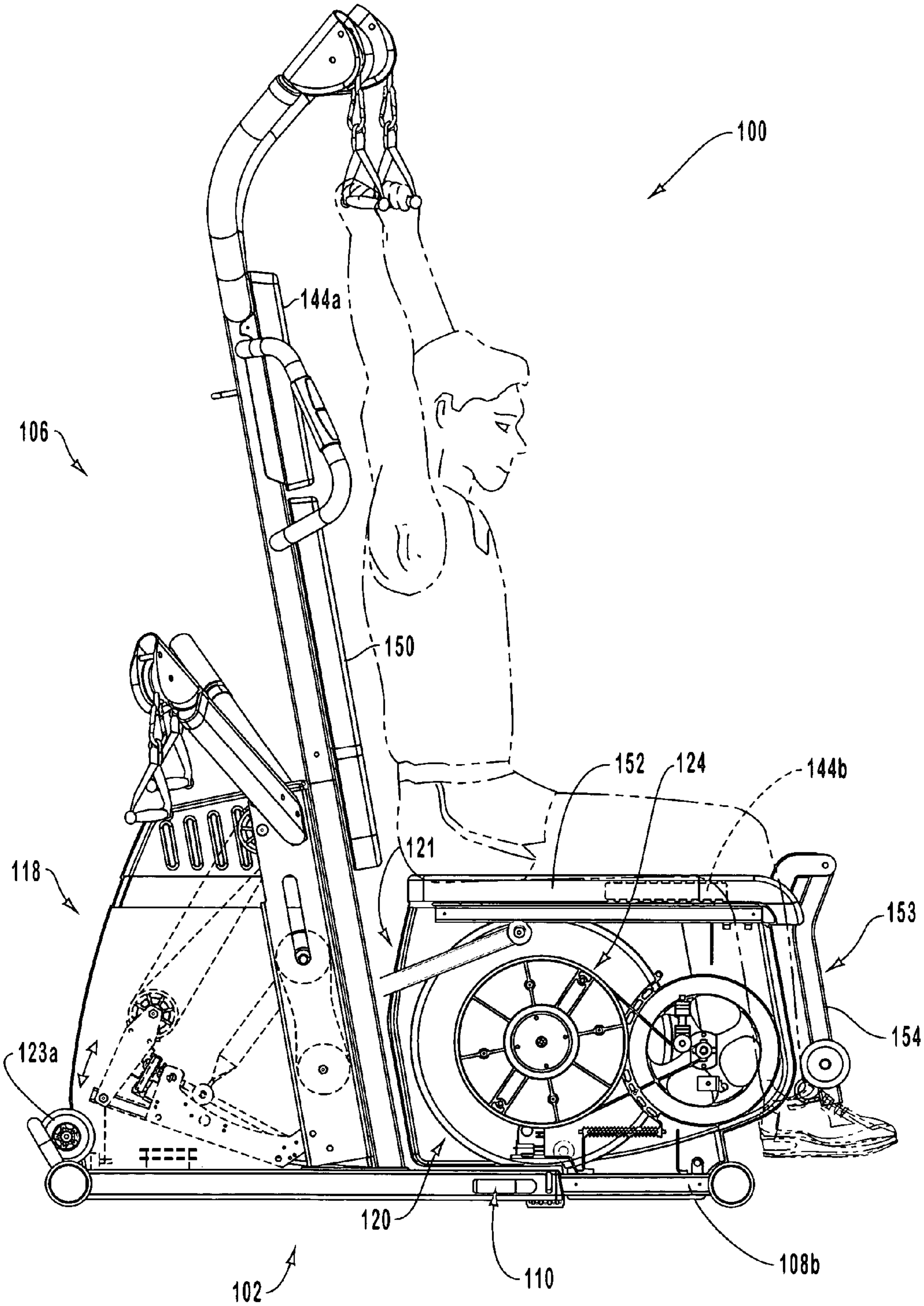
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Fig. 1B

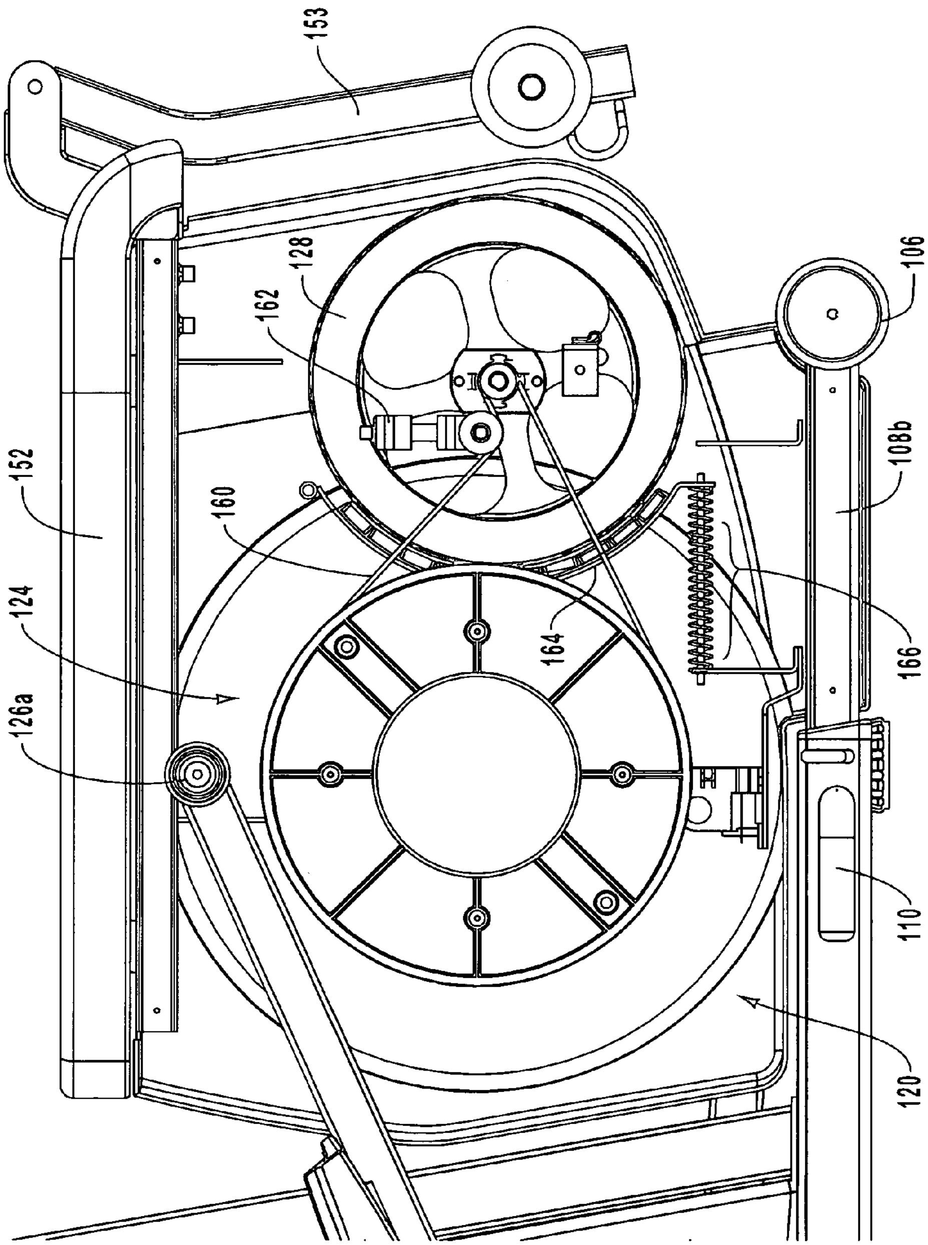


Fig. 2A

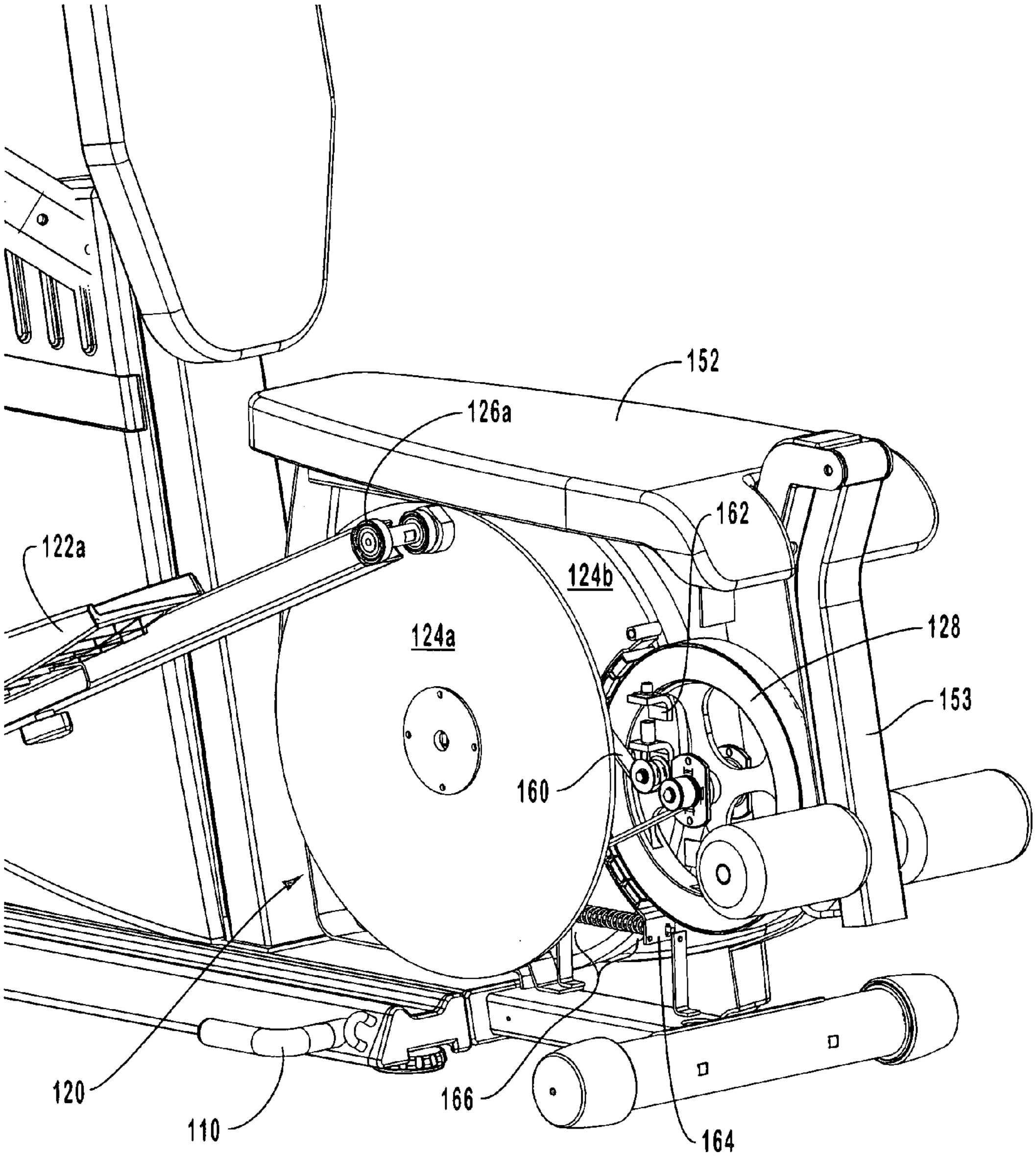


Fig. 2B

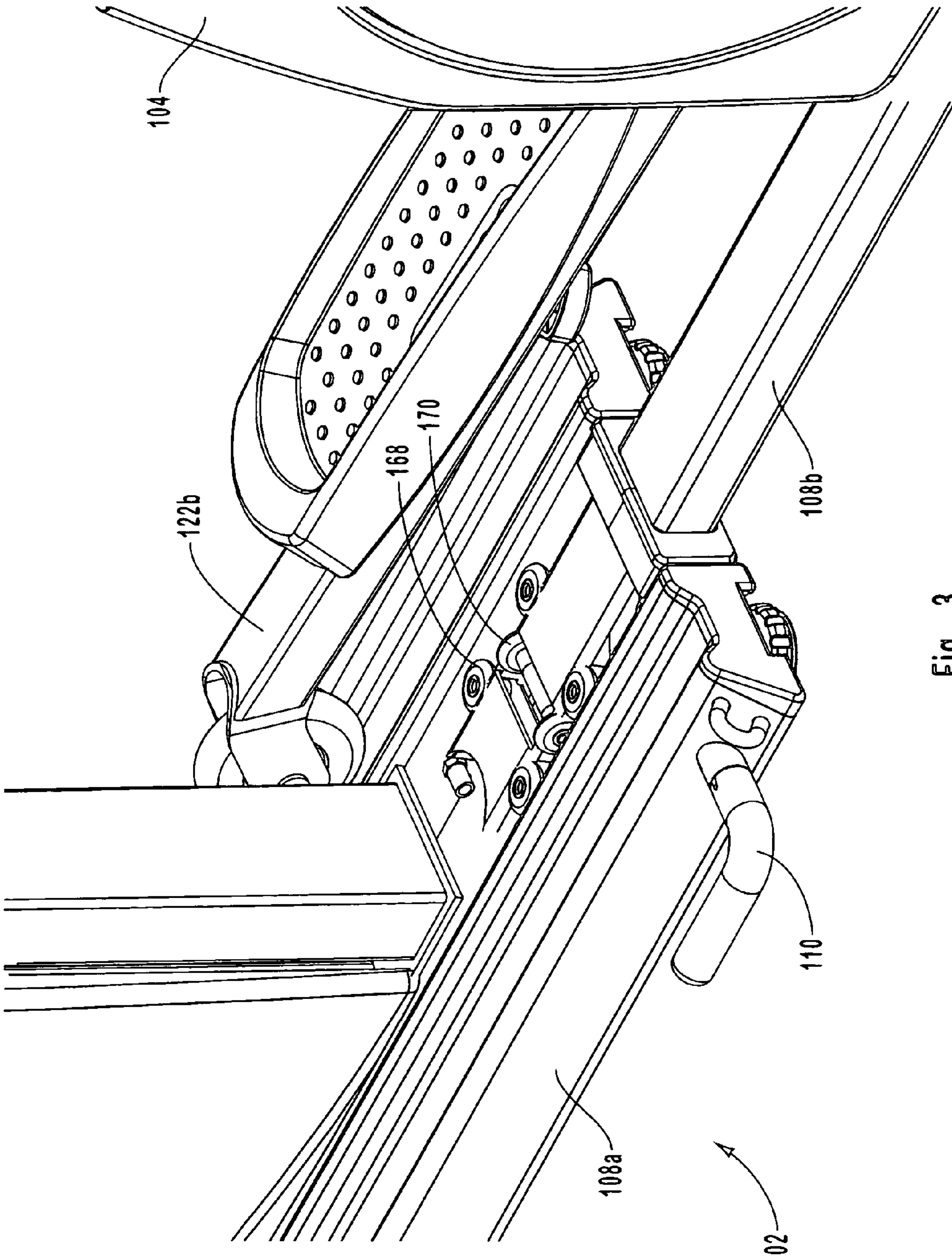


Fig. 3

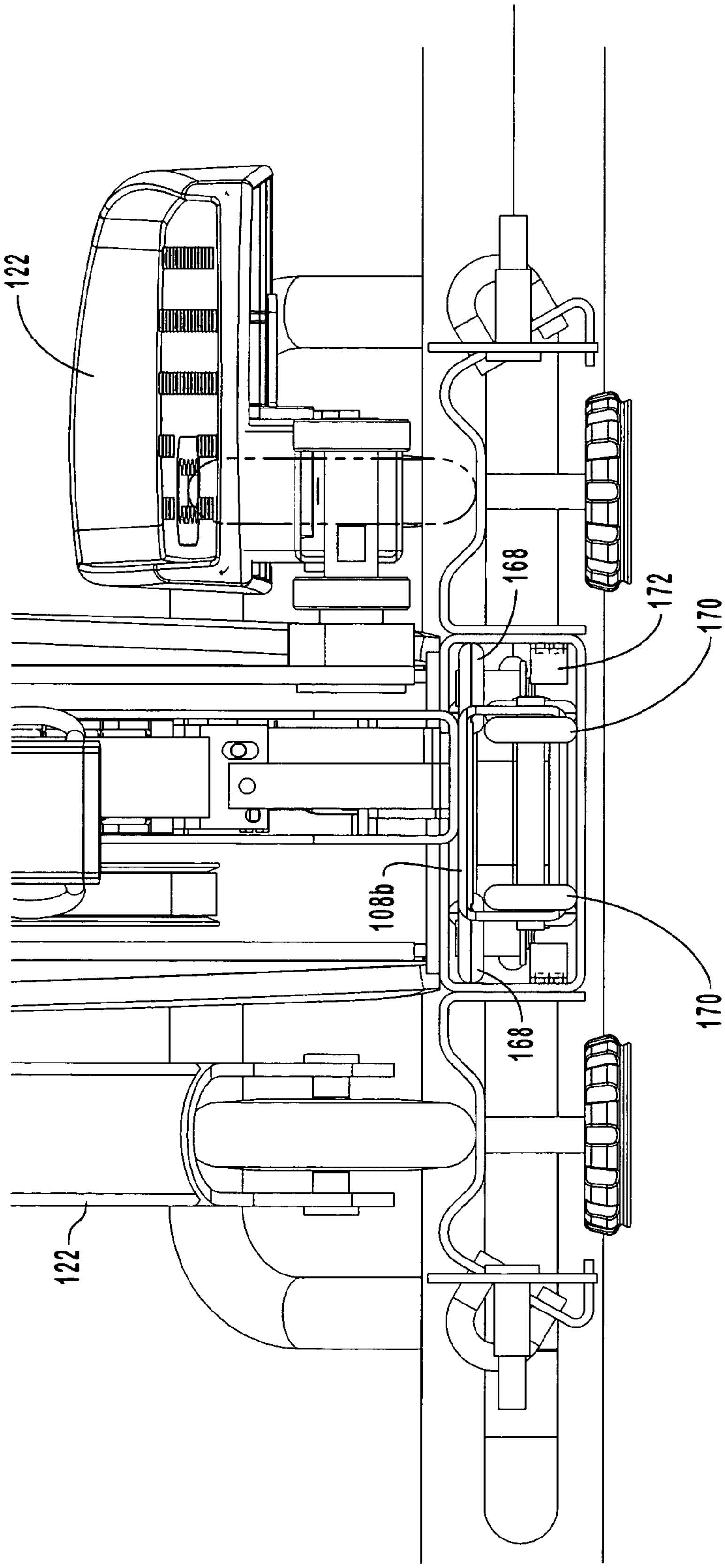


Fig. 4

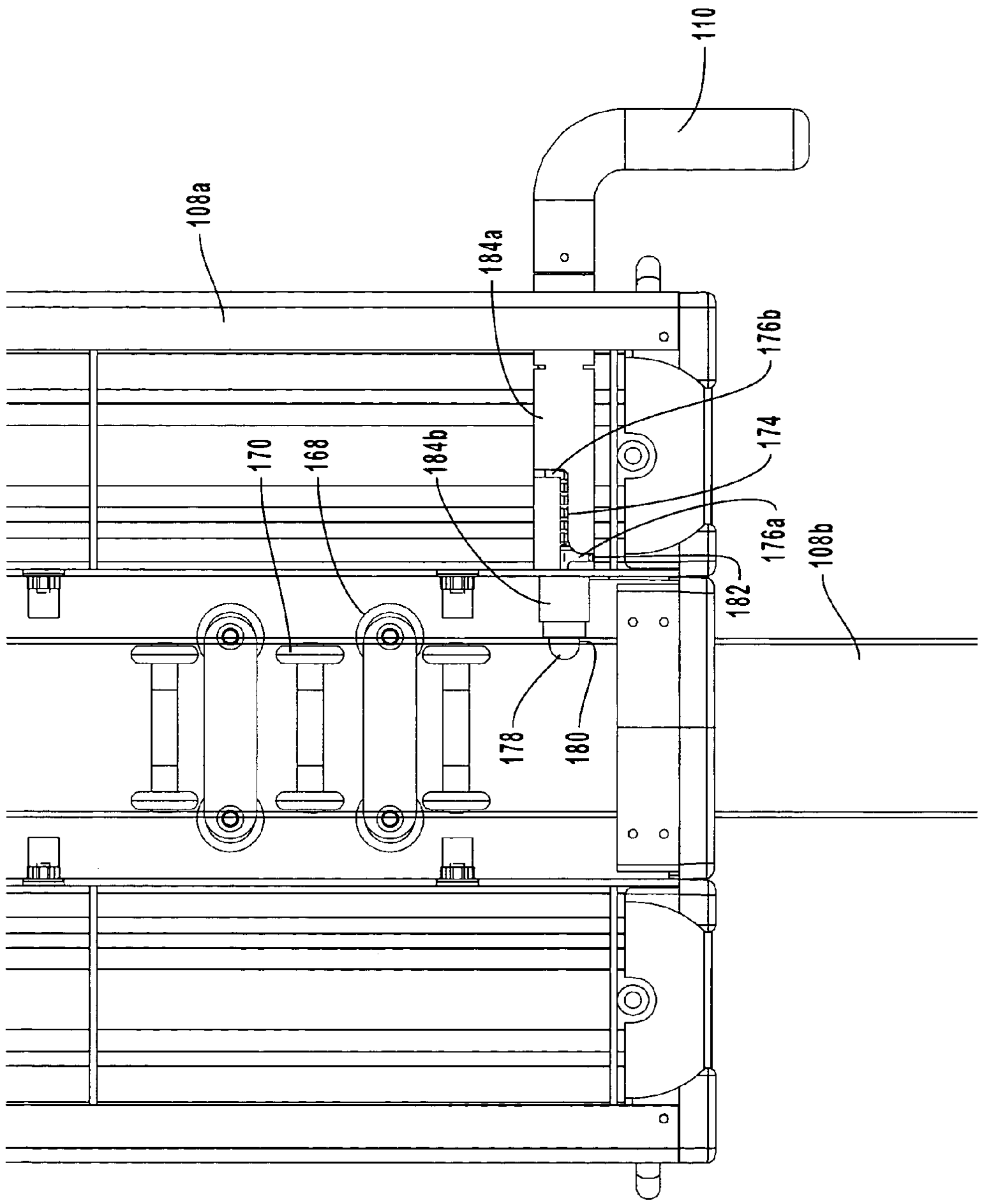


Fig. 5A

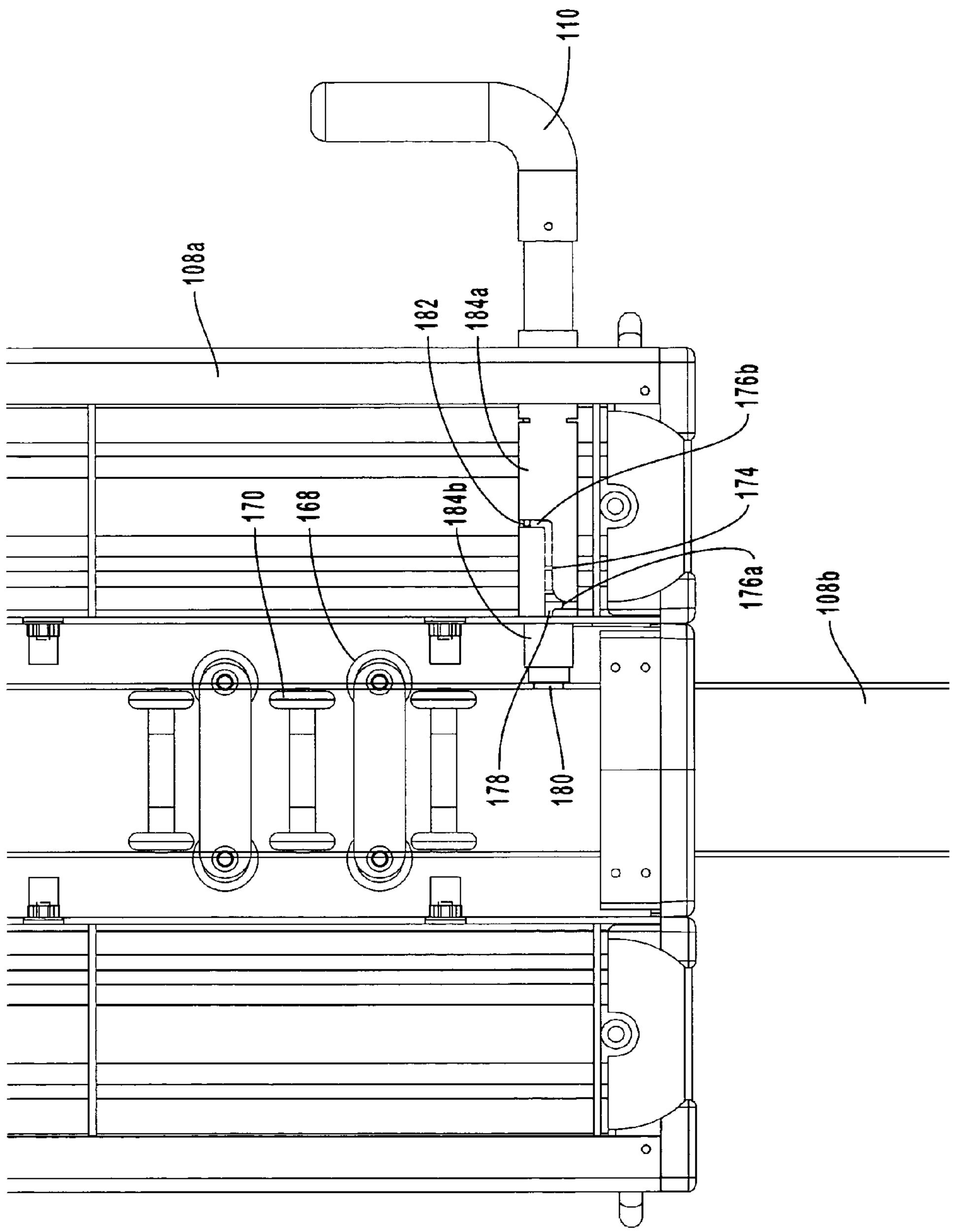


Fig. 5B

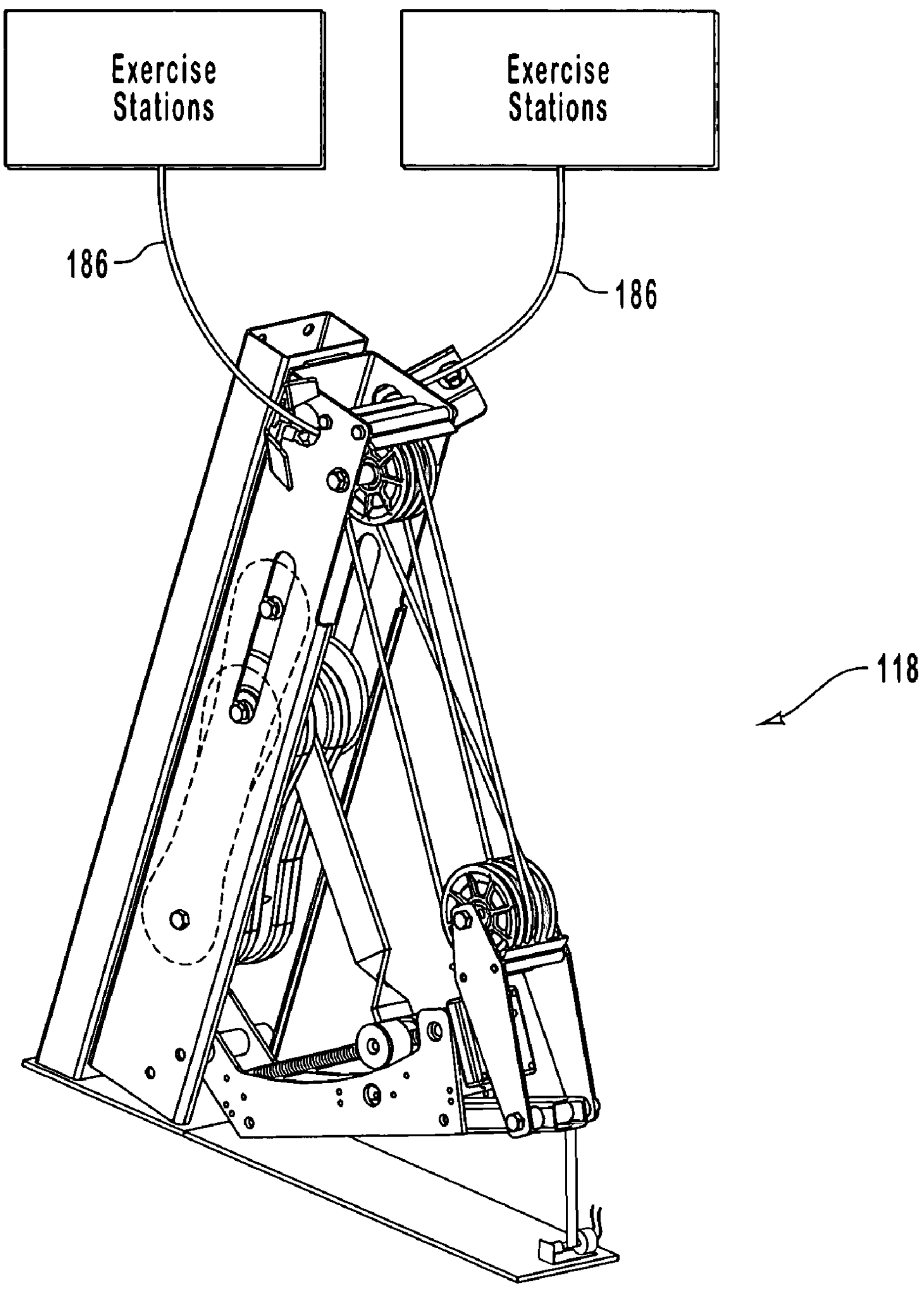
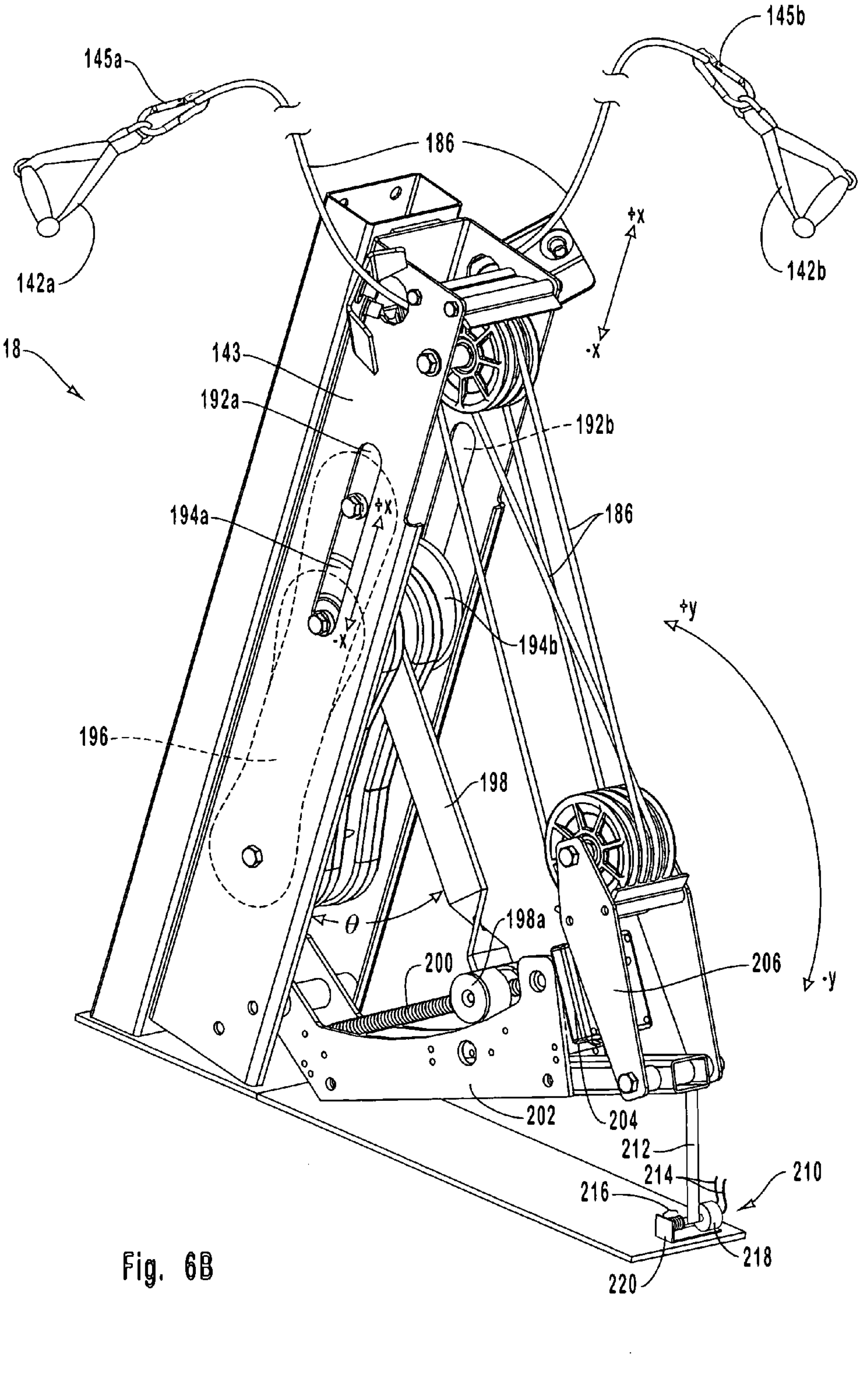


Fig. 6A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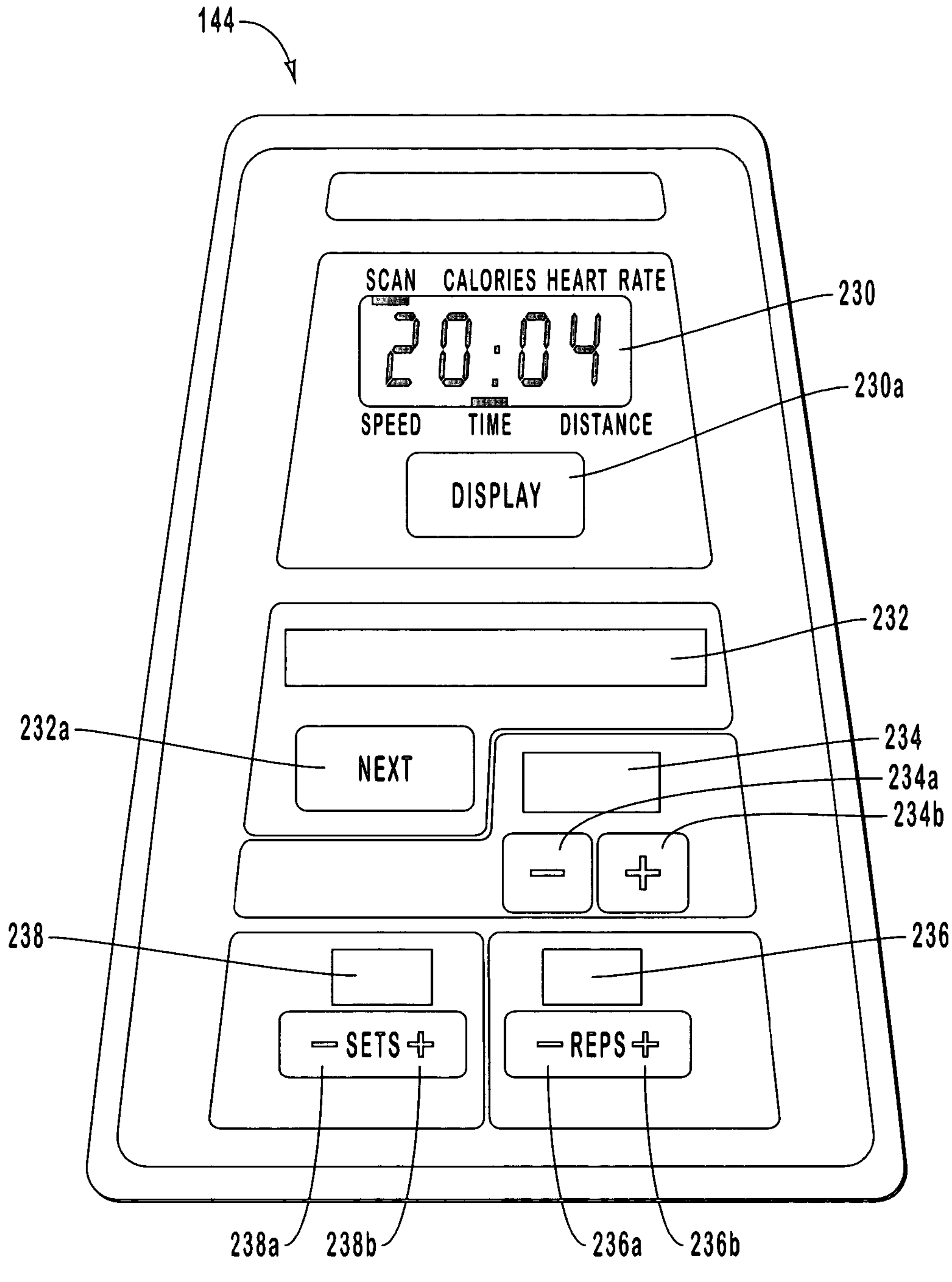
218
220

Fig. 6B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SPEED TIME DISTANCE
DISPLAY
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232
232a
NEXT
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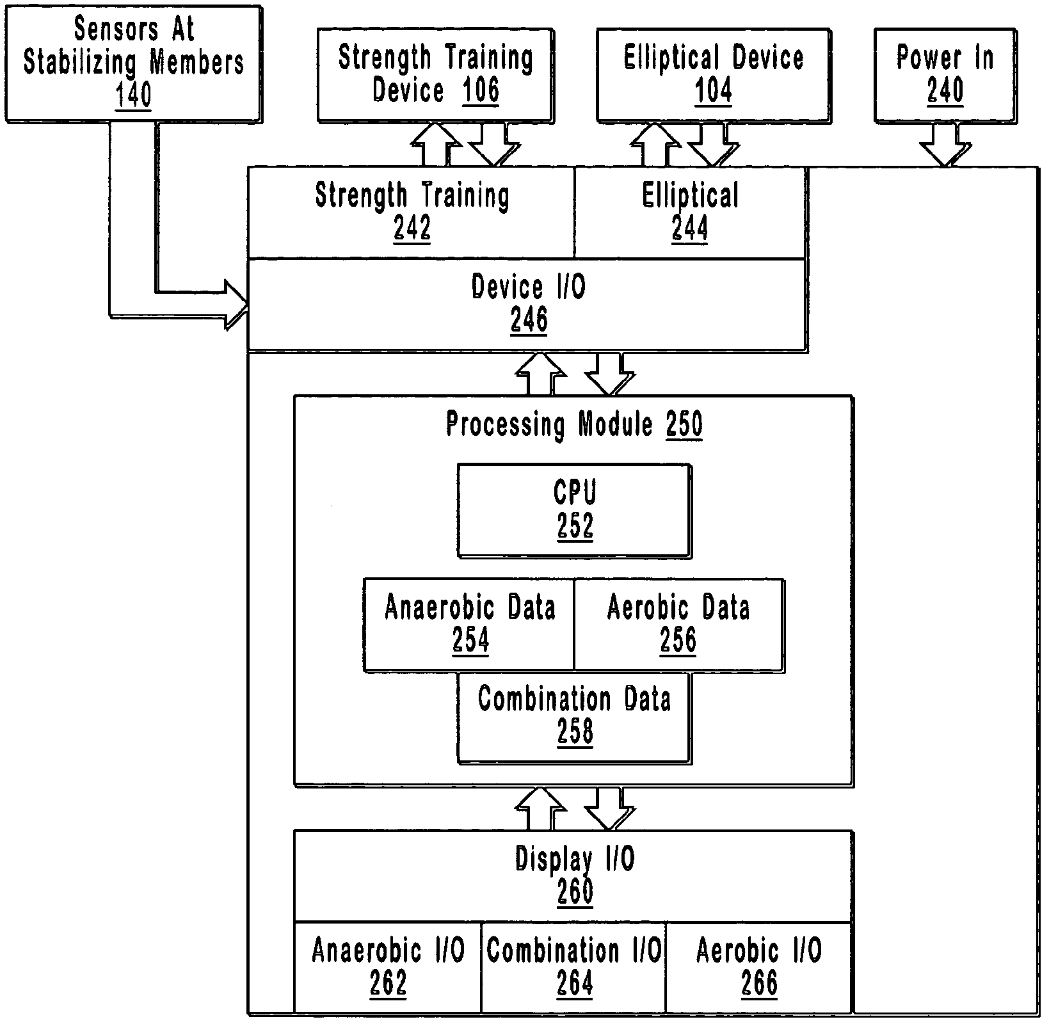
234a
234b
238
236
SETS
REPS
238a
238b
236a
236b

Fig. 7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Elliptical Device 104
Power In 240
Strength Training 242
Elliptical 244
Device I/O 246
Processing Module 250
CPU 252
Anaerobic Data 254
Aerobic Data 256
Combination Data 258
Display I/O 260
Anaerobic I/O 262
Combination I/O 264
Aerobic I/O 266

Fig. 8

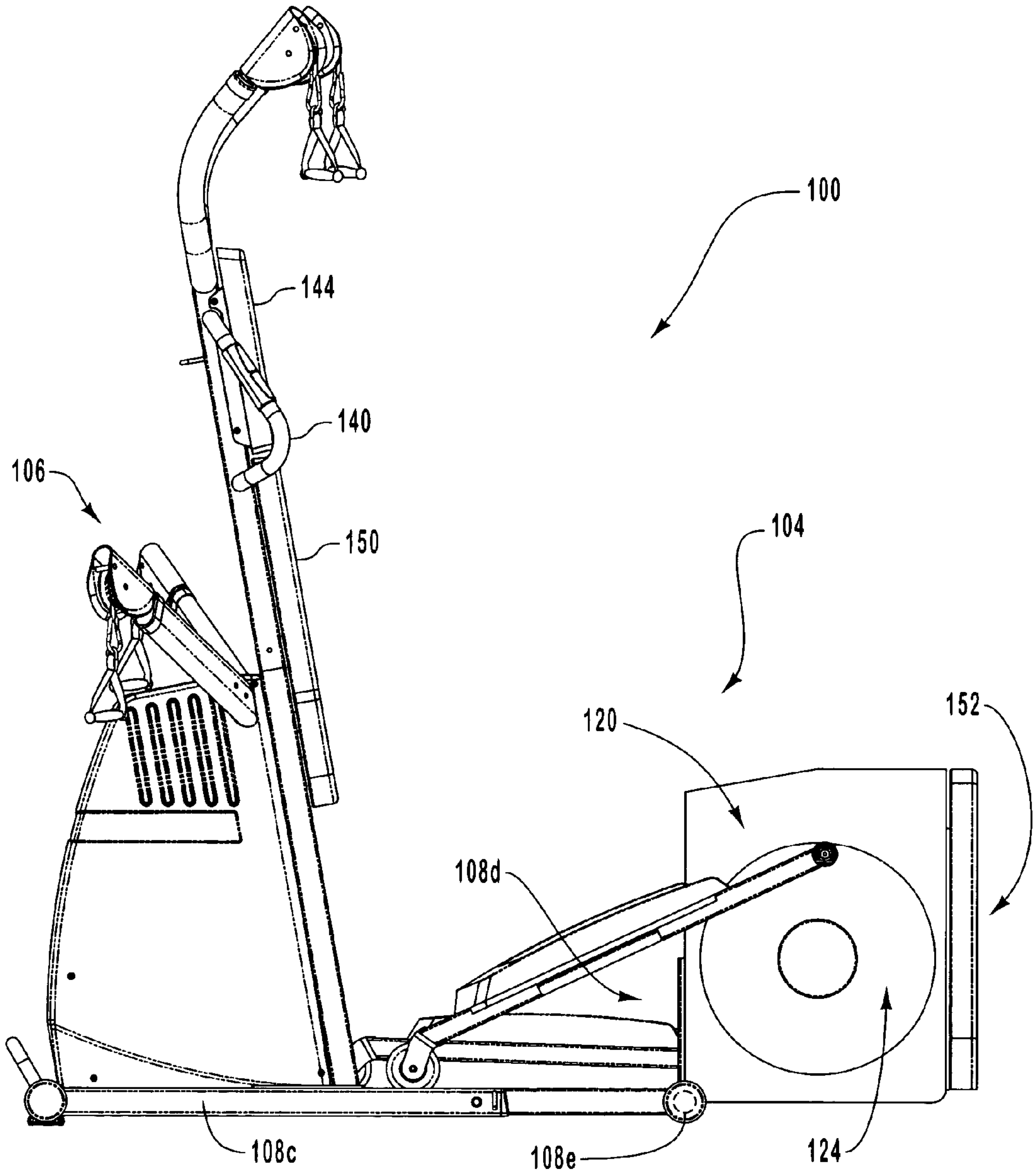

Fig. 9A

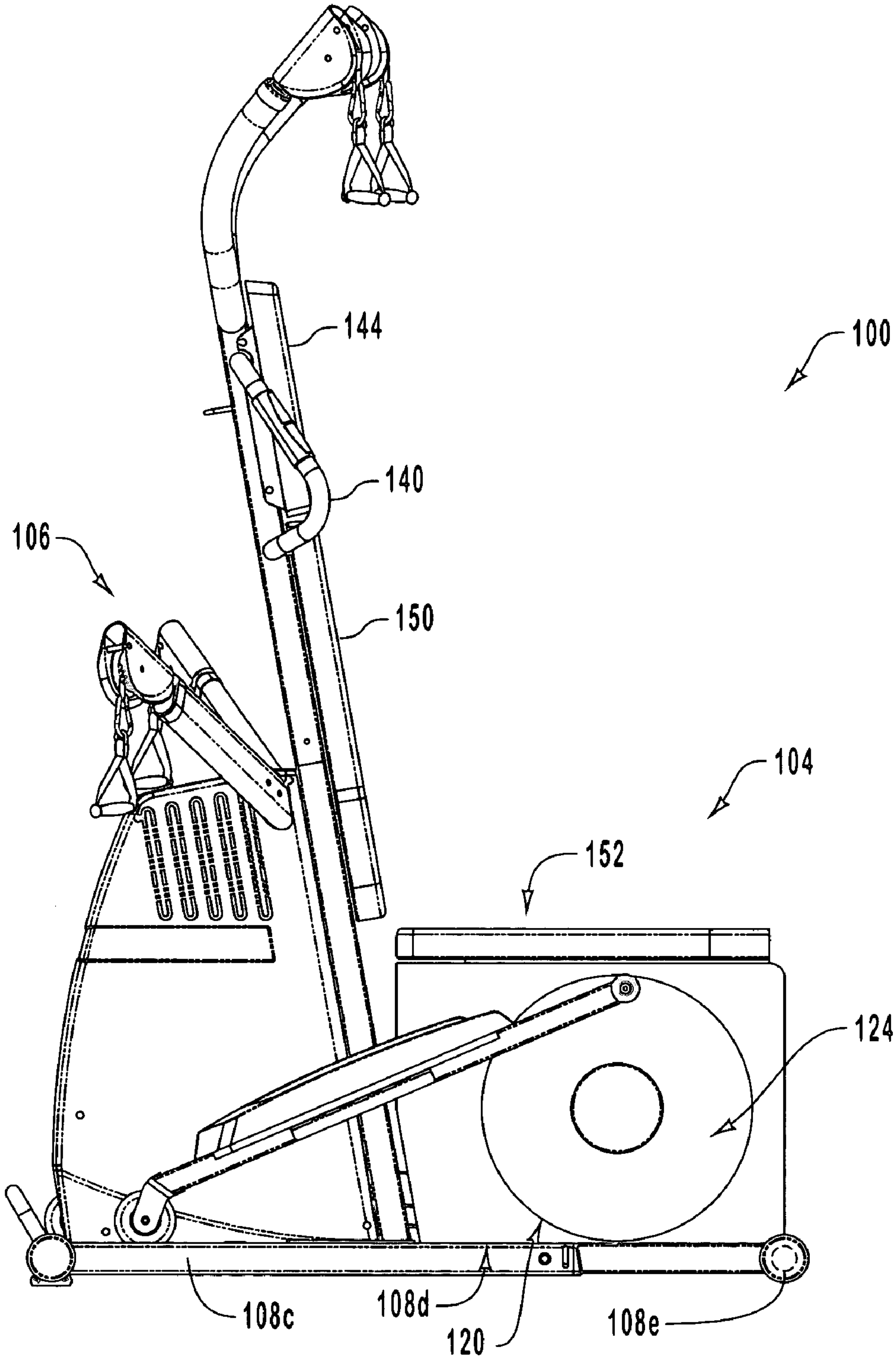

Fig. 9B

ELLIPTICAL EXERCISE MACHINE WITH INTEGRATED ANAEROBIC EXERCISE SYSTEM

BACKGROUND OF THE INVENTION

[0001] 1. The Field of the Invention

[0002] The present invention relates to exercise equipment and, more specifically, to exercise devices that provide aerobic and anaerobic activities.

[0003] 2. The Prior State of the Art

[0004] In the field of exercise equipment, a variety of devices have been developed to strengthen and condition muscles commonly used for a variety of activities, including both anaerobic and aerobic activities. Generally speaking, anaerobic activities include activities that require voluntary acting muscles to flex a significant amount during a relatively small number of repetitions, such as while engaging in strength training, e.g., with free weights or an exercise device having a cable-based resistance system. Exercise devices that enable anaerobic exercise include weight systems that provide one or more exercises based on a common resistance mechanism, such as one or more handles or bars coupled to a weight stack or other resistance mechanism via a cable-based system having one or more cables and pulleys.

[0005] By contrast, aerobic activities include activities that are designed to dramatically increase heart rate and respiration, often over an extended period of time, such as running, walking, and swimming for several minutes or more. Aerobic conditioning devices that simulate such activities have typically included treadmills, stepping machines, elliptical machines, various types of sliding machines, and so forth.

[0006] Recently, elliptical machines have proven especially popular for allowing a user to perform aerobic ambulatory exercises (e.g., walking or running) with moderate to significant intensity, while at the same time providing low impact to the user's joints.

[0007] Unfortunately, present exercise systems are generally configured for only one of anaerobic exercises and aerobic exercises, but not for both. This can create a tension for a user since both anaerobic and aerobic exercises can be important components of an exercise regimen. The tension can be heightened since anaerobic and aerobic exercise systems each separately take up a certain amount of space that a user may want to devote to other items, and since each such exercise system can be relatively expensive. Accordingly, a user may be reluctant to purchase both types of individual exercise systems due to any number of cost and space constraints.

[0008] As a result, a user may purchase only one type of exercise system, but then forego the benefits of the alternative exercise activities. This is less than ideal for users who desire to implement a complete workout regimen. Alternatively, the user may purchase only one type of exercise system, but then purchase an additional membership to a workout facility to exercise on other apparatuses in different ways. This is less than ideal at least from a convenience standpoint.

[0009] Accordingly, an advantage can be realized with exercise apparatuses that can provide the benefits of multiple types of exercises in a convenient and cost-effective manner.

BRIEF SUMMARY OF THE INVENTION

[0010] Exemplary embodiments of the present invention include systems, apparatuses, and methods that enable a user to perform anaerobic and/or aerobic activities on a compactable exercise machine. In particular, a user can move an exercise machine into a contracted position, an expanded position, or some combination therebetween, so that the user can access the exercise machine for primarily aerobic exercise, primarily anaerobic exercise, or some combination of both, as appropriate.

[0011] An exemplary exercise system may comprise an elliptical exercise device and a strength training device mounted on a telescoping frame. When the telescoping frame is expanded, a user can conveniently engage in elliptical exercises. When the telescoping frame is contracted, a user can conveniently engage in strength training exercises. The telescoping frame also provides convenient storage.

[0012] At least a portion of one exercise device, such as certain operable components of the elliptical device, can be mounted on one part of the frame, while at least a portion of the other device, such as certain operable components of the strength training device, can be mounted on another part of the frame. As such, the two portions can be telescopically contracted and expanded, relative to the other.

[0013] In addition, one or more sensors and motors can be positioned within the exercise system. The one or more sensors and motors can be configured to transfer (or perform an action on) respective electronic signals sent to and/or from a user. An electronic console can facilitate the signal transfers, and can receive (and send) electronic signals from the one or more sensors or motors. In one implementation, the electronic console can allow a user to view exercise progress in both anaerobic and aerobic workouts, and/or to adjust anaerobic and aerobic resistance mechanisms.

[0014] These and other benefits, features, and advantages of the present invention will become more fully apparent from the following description and appended claims, or may be learned by practicing the invention as set forth below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] A more extensive description of the present invention, including the above-recited features and advantages, will be rendered with reference to the specific embodiments that are illustrated in the appended drawings. Because these drawings depict only exemplary embodiments, the drawings should not be construed as imposing any limitation on the present invention's scope. As such, the present invention will be described and explained with additional specificity and detail through use of the accompanying drawings in which:

[0016] **FIG. 1A** is a side view of a telescoping exercise system having an aerobic, elliptical device and an anaerobic, strength training device in accordance with an implementation of the present invention;

[0017] **FIG. 1B** is a side view of the exercise system depicted in **FIG. 1A**, wherein the system is contracted;

[0018] **FIG. 2A** is a close up, side view of the operating components of the elliptical device of the exercise device of **FIGS. 1A-2A**;

[0019] **FIG. 2B** is a side perspective view of the elliptical device depicted in **FIG. 2A**;

[0020] **FIG. 3** is a close up, top perspective view of a telescoping portion of the frame of the exercise system depicted in **FIGS. 1A-2A**;

[0021] **FIG. 4** is a close up, front view of the telescoping frame shown in **FIG. 3**;

[0022] **FIG. 5A** is a plan view of a release handle and related components of the telescoping frame shown in **FIG. 3**;

[0023] **FIG. 5B** is a plan view of the release handle and related components depicted in **FIG. 5A**, wherein the release handle and related components are disengaged;

[0024] **FIGS. 6A and 6B** are side perspective views of an anaerobic resistance assembly and repetition sensor of the exercise system of **FIGS. 1A and 1B**;

[0025] **FIG. 7** is front view of an electronic console of the exercise system of **FIGS. 1A and 1B** for managing anaerobic and aerobic exercise information in accordance with an implementation of the present invention;

[0026] **FIG. 8** is a software block diagram for receiving, processing, and displaying information on an electronic console such as the console of **FIG. 7**;

[0027] **FIG. 9A** is a side view of an elliptical device mounted on another embodiment of a multi-part frame, wherein the elliptical device is expanded relative to the strength training device in a pivoting fashion; and

[0028] **FIG. 9B** is a side view of **FIG. 9A** wherein the elliptical device is compacted relative to the strength training device in a pivoting fashion.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] The present invention relates generally to systems, apparatuses, and methods that enable a user to perform anaerobic and/or aerobic activities on a compactable exercise machine. In particular, a user can move an exercise machine into a contracted position, an expanded position, or some combination therebetween, so that the user can access the exercise machine for primarily aerobic exercise, primarily anaerobic exercise, or some combination of both, as appropriate.

[0030] **FIGS. 1A and 1B** demonstrate respective extended and contracted views of an aerobic and anaerobic exercise system **100** comprising: (i) a multi-part, telescoping frame **102**; (ii) an aerobic, elliptical exercise device **104** coupled to frame **102**; and (iii) an anaerobic, strength training device **106** coupled to frame **102**. The strength training device **106** shown has a cable-based resistance system, although other systems may also be employed in place of device **106**.

[0031] A multi-part frame, such as telescoping frame **102**, allows exercise system **100** (also referred to sometimes as an exercise "machine") to be (i) extended, enabling convenient aerobic, elliptical exercise; or (ii) compacted, enabling convenient anaerobic, strength training exercise. By enabling convenient elliptical exercise and/or strength training exercise, system **100** is efficient and economic. Also, by being compactable, system **100** can be conveniently stored. Strength training device **106** is compact and lightweight. Frame **102** and devices **104**, **106** form a unique exercise apparatus to which a unique electronic console (or unique electronic console system) is coupled. These and other advantages will now be described in additional detail, beginning with a description of the telescoping frame **102** shown in **FIGS. 1A-1B**.

[0032] Telescoping frame **102** comprises a stationary portion **108*a*** and a telescoping portion **108*b***. Generally, a "telescoping portion" can be understood as a moving portion that moves inside or away from a "stationary portion". Of course, a manufacturer can also configure telescoping frame **106** such that portion **108*b*** is actually the stationary portion, and such that portion **108*a*** is actually the telescoping portion. As such, designations of "telescoping" or "stationary" with respect to the frame components are arbitrary, and may be switched by the manufacturer depending on the type of components used in the exercise system **100**.

[0033] In one implementation, stationary portion **108*a*** and telescoping portion **108*b*** can be configured such that telescoping portion **108*b*** cannot completely separate from the stationary portion **108*a*** after full expansion. The stationary portion **108*a*** and telescoping portion **108*b*** can also be configured such that the telescoping portion **108*b*** can be fully contracted with respect to the stationary portion **108*a*,** fully expanded from the stationary portion **108*a*,** or only partially expanded or contracted. As such, a manufacturer can implement a wide variety of options for configuring a contractible exercise system **100**.

[0034] Continuing with **FIG. 1A**, frame **102** further comprises one or more release handles **110** for contracting or expanding frame **102**, and one or more rollers **112*a-b*,** in order to help position the system **100**. Release handle **110** releasably secures frame **102** at different states of contraction or expansion. Rollers **112*a-b*** are positioned at an end of one or more of the stationary portion **108*a*** and the telescoping portion **108*b***. Rollers **112*a-b*** can help a user move the entire exercise system **100** and rollers **112*b*** can also help move the telescoping portion **108*b*** within and without the stationary portion **108*a*,** as needed.

[0035] Frame **102** further comprises (i) an upstanding member **114** that is coupled to stationary portion **108*a*;** and (ii) pulley attachment beams **116*a-b*** which extend from upstanding member **114** at different positions to provide the user with exercise access points to a resistance assembly **118** of the strength training device **106**. Additional details relating to the telescopic coupling of frame **110** will be discussed in detail below.

[0036] With continued reference to **FIGS. 1A-1B**, elliptical exercise device **104** will now be discussed in additional detail. Elliptical exercise device **104** comprises (i) a crank **120** movably coupled to telescoping portion **108*b*** of frame **102**; and (ii) first and second opposing foot supports **122*a-b*** movably coupled to crank **120**. In one implementation, the crank **120** is coupled to the telescoping portion **108*b*** through a bracket (not shown). For example, the bracket may comprise a securing portion at the lower end of the bracket for securing the bracket to the telescoping portion **108*b***. The bracket may further comprise an extension that terminates in a perpendicular axle. The crank **120** may then be mounted on the bracket about the axle. In another implementation, the axle can extend from an inner wall of the elliptical device **104** housing.

[0037] In the illustrated implementation, the crank **120** further comprises means for providing the back ends of the opposing foot supports **11***a-b* with cyclical motion. To provide such a motion, the illustrated crank **120** comprises a flywheel **124** that rotates about an axis. The flywheel **124** comprises pivoting rods **126***a-b* that are mounted about the flywheel **124** periphery, and that extend in opposite directions relative to each other. In the illustrated implementation, one pivoting rod **126***a* is positioned approximately 180° about the flywheel **124** periphery relative to the other pivoting rod **126***b*. The opposing foot supports **122***a-b* are then pivotally joined to the flywheel **124** at the respective, pivoting rods **126***a-b*. When the flywheel **124** turns a given direction, the back end of the foot supports **122***a-b* move in a respectively cyclical motion about the flywheel **124** axis.

[0038] One will appreciate, however, that other implementations of a crank **120** can be used in accordance with the present invention. For example, the crank can comprise two opposing arms that rotate about an axis, such as bicycle-type crank arms (not shown), wherein the back end of the foot supports **122***a-b* pivotally connect to the extreme ends of the arms. In another implementation, the crank comprises two opposing flywheels rotating about the same axis, wherein one pivoting rod extends from one flywheel, and the opposing rod extends in an opposite direction from the opposing flywheel. In each case, the given crank simply provides the foot supports **122***a-b* with cyclical motion.

[0039] Continuing with the elliptical device **104**, the front ends of the respective foot supports **122***a-b* comprise respective wheels **123***a-b* that are configured to move in basically linear back and forth motions. In use, wheels **123***a-b* of respective foot supports **122***a-b* contact and move back and forth within grooves on the stationary portion **108***a* of frame **102**. This results in an overall elliptical motion for the elliptical device **104** when combined with the cyclical motion of the foot support **122***a-b* back ends.

[0040] Elliptical device **104** further comprises (i) a resistance wheel **128** movably coupled via a belt to flywheel **124**; and (ii) a resistance mechanism that adjustably applies resistance to the resistance wheel **128** (e.g., through magnetic resistance), which together serve to adjust resistance to the movement of flywheel **124**.

[0041] Thus, in the implementation shown in **FIG. 1A**, the operable components (e.g., foot supports **12***a-b* and crank **120**) of elliptical device **104** are coupled to the telescoping portion **108***b* of frame **102**, whereby such components of device **104** are easily positioned close to or away from strength training device **106**. Such operable components can be coupled alternatively to stationary portion **108***a* of frame **102**, while the anaerobic device **106** can be coupled to the telescoping portion **108***b*. In such an alternative embodiment, the anaerobic device **106** may be movably positioned with respect to the aerobic device **104**.

[0042] Also as shown in **FIGS. 1A and 1B**, elliptical device **104** further comprises first and second user stabilizing handles **140** (only one shown handle **140** shown) coupled to opposing sides of upstanding member **114** and extending rearward in order to be conveniently grasped by a user. Stabilizing handles **140**, can provide balance during certain exercises, and may also include sensors (not shown) that measure the user's pulse during still other exercises. Upstanding member **114** further provides a convenient post on which to mount some or all of the components of anaerobic device **106**.

[0043] Anaerobic device **106** comprises (i) a resistance assembly **118** coupled to the front portion of upstanding member **114**; and (ii) one or more exercise stations, such as pull handles **142***a-d* linked to resistance assembly **118** via a pulley and cable system that is coupled to and extends through frame **102**. Resistance assembly **118** provides adjustable resistance to movement of handles **142***a-d*. **FIGS. 1A and 1B** generally depict the components and use of resistance assembly **118** in solid and broken lines. As shown, resistance assembly **118** comprises a resistance assembly frame **143** that is coupled to upstanding member **114**. The additional components of resistance assembly **118** will be described in additional detail below.

[0044] Implementations of the exercise system **100** include one or more electronic consoles **144** that gathers, receives, processes, and displays data between one or more components (e.g., stabilizing handles **140**), as well as the aerobic, elliptical device **104** and anaerobic, strength training device **106**. For example, data received from sensors mounted on opposing right and left stabilizing handles **140** are output directly at a display interface on the electronic console **144**, thereby indicating the user's heart rate. Furthermore, data received from each of elliptical device **104** and strength training device **106** can be combined, processed, and displayed as appropriate back to the user.

[0045] With continued reference to FIGS. 1A-B, system **100** can further comprise additional features which aid the user in either comfort or balance. For example, a pad **150** is attached to upright member **114**, and can be useful as a knee pad when a user is facing pad **150**, or as a backrest when a user is seated (as in **FIG. 1B**), or when the user is facing away from pad **150** and desires to rest against it, depending upon a given exercise. Furthermore, a pad **152** is mounted on a housing **121** surrounding the crank **120**, forming a padded bench on which a user can sit while performing exercises.

[0046] A leg exercise system, such as a leg extension assembly **153**, comprising a leg extension bar **154** is movably coupled to pad **152**, thereby enabling knee extension exercises. The leg extension assembly **153** further comprise leg contact members **155** (only one shown) on opposing sides of bar **154**. A cable may connect a hook **156** mounted on bar **154** to resistance assembly **118** (e.g., by connecting to handle **142***a* or a connector associated therewith). The cable may extend from hook **156** through hooks **158***a-b* to handle **142***a* (or an associated connector) in order to keep the cable away from the operable components of elliptical device **104**.

[0047] In one implementation, a user may desire to sit on the pad **152** and perform anaerobic, strength training exercises at one or more exercise stations when crank **120** is positioned close to strength training device **106** (e.g., as in **FIG. 1B**). This can enable the user to lean back against pad **150** when sitting to perform certain exercises, e.g., by pulling one or more handles **142***a-d*, or by performing leg extensions against using assembly **153**. Of course, specific positioning of crank **120** with respect to the anaerobic device **106** is not required for all aerobic or anaerobic activity on exercise system **100**.

[0048] **FIG. 1B** further shows that the exercise system **100** can comprise multiple electronic consoles in an electronic console system, such as electronic consoles **144***a* and **144***b* (phantom). For example, one electronic console **144***a* can be mounted directly to the frame **114**, while another electronic console **144***b* can be embedded inside pad **152** so that it is viewed when the user is seated. In one embodiment, one electronic console **144***a* is configured to display primarily aerobic data, while a second electronic console **144***b* is configured to display anaerobic data based on use of the strength training device **106**. In other embodiments, the exercise system **100** can further comprise an electronic console system having three or more electronic consoles for specific exercise devices, as appropriate.

[**0049**] Thus, for example, a workout or training program can be geared to display information through each of the one or more electronic consoles (e.g., one console—**144**, or multiple consoles—**144***a,* **144***b,* etc., as appropriate). In particular, the workout or training program can be configured to output elliptical workout instructions, and elliptical data at one display interface (e.g., console **144**, or **144***a,* as appropriate), and, at an appropriate time, output strength training workout instructions and related strength training workout data at the same or another display interface (e.g., console **144**, or **144***b,* as appropriate). For example, strength training and elliptical exercise data can be displayed at one or more corresponding display interfaces at one electronic console **144**. Alternatively, elliptical data can be displayed through one or more corresponding display interfaces at electronic console **144***a,* while strength training data is displayed only at the corresponding one of multiple electronic console **144***b.*

[**0050**] In this manner, one console **144** or multiple consoles **144***a,* **144***b* of the exercise system **100** (which are user linked), can be utilized to perform "circuit training" with anaerobic and aerobic exercises. In general, circuit training involves implementation of an exercise program to direct a user to perform certain exercises on one machine, and other exercises on another machine. This can be done through displays at one console, or through multiple displays (e.g., first and second displays) at respective multiple consoles. For example, an exercise program can be displayed to a user through a first console display at one exercise device, telling a user to perform 15 minutes of aerobic training; and then the program can direct the user to another, second, console display, where the second display tells the user to perform 25 repetitions of another exercise on a strength training device, and so forth. In one implementation, the circuit training identifies the user or exercise data as it is performed, can modify its instructions accordingly, and completes after the user has finished the instructions shown at each corresponding one or more displays.

[**0051**] **FIG. 2A** and the following discussion outline the elliptical device **104** in greater detail. For example, the illustrated elliptical device **104** comprises pivoting rods **126***a* and **126***b* that connect the respective backend of a foot support (e.g., **122***a* and **122***b*) to flywheel **124**. Belt **160** couples the flywheel **124** to the resistance-based, flywheel **128**. A belt tensioner **162**, positioned along the belt **160**, can help keep the belt tensioned so that it does not slip out of position.

[**0052**] The elliptical device **104** also comprises a "C"-shaped aerobic resistor **164** for adjusting the elliptical resistance, wherein the aerobic resistor **164** can be varied at least in part by a spring-based adjustment system **166**. For example, aerobic resistor **164** is configured such that contraction of the aerobic resistor **164** by the spring-based adjustment system slows the movement of the resistance flywheel **128**; while releasing the braking mechanism **164** frees the motion of the resistance flywheel **128**. In one implementation, the aerobic resistor **164** may comprise eddy magnet brakes, although a wide variety of brakes or other resistance apparatus can be used within the context of the invention. The spring adjuster **166** contracts or expands the aerobic resistor **164** relative to the resistance flywheel **128**. In one implementation, the spring adjuster **166** may be adjusted based on user input (e.g., through electronic signals sent from the console **144** to a motor coupled to the spring adjuster **166**).

[**0053**] The implementation of **FIG. 2B** further shows that the pivoting rod **120** comprises two solid disk flywheels **124** (i.e., **124***a* and **124***b*). In particular, the flywheels **124***a*-*b* are each connected about an axle, where one disk is connected to a foot support **122***a* through a pivoting rod **126***a,* while another disk is connected to the other foot support **122***b* through another pivoting rod **126***b.* Alternatively, the flywheel **124** may comprise one solid disk positioned about an axle, where the flywheel **124** also connects to the respective foot supports with respective pivoting rods **126***a* and **126***b.* Generally, a solid disk flywheel **124** can provide additional balance and stability to the elliptical exercise system **104**, in addition to some cost considerations. For example, it may be less expensive, in some implementations, to use a solid disk as the outer wall of an aerobic system **104** housing **121**.

[**0054**] **FIG. 3** and the following description provide detail concerning the telescoping frame **102** and associated components. For example, as shown in **FIG. 3**, one or more inner side rollers **168** roll along the side walls of the inner cavity in the stationary portion **108***a.* As well, one or more bottom rollers **170** roll along the lower surface of the inner cavity of the stationary portion **108***a.* At least one advantage to using side and bottom rollers in this manner is that rollers **168** and **160** can help metallic frame parts move together much more fluidly than, for example, using only grease to overcome frictional forces. Furthermore, the ease of movement provided by the described rollers can make the compacting and expanding ability of the exercise system **100** accessible to any user.

[**0055**] **FIG. 4** illustrates a front view of the telescoping portion **108***b* when the telescoping portion **108***b* is positioned within the stationary portion **108***a,* such that the exercise system **100** is compacted. In one implementation, one or more stoppers set toward the front of the stationary portion **108***a* may be used to set a maximum insertion point of the telescoping portion **108***b.* This can be done when one or more of the wheels **160** of the telescoping portion **108***b* abut the one or more respective stoppers of the stationary portion **108***a* when the exercise system **100** is fully compacted. In another implementation, one or more back stoppers (not shown) can be used to set a maximum expansion point of the telescoping portion **108***b* relative to the stationary portion.

[**0056**] At or between the maximum and minimum compaction points, releasable securing means, such as release handle **110**, can be used to secure the telescoping portion **108***b* in various positions. For example, **FIG. 5A** illustrates a release handle **110** in an engaged (or "secured") position with respect to the stationary portion **108***b*. As used herein, the term "engaged" can refer generally to a position of the release handle **110**, in which the telescoping portion **108***b* can be prohibited from compacting or expanding, relative to the stationary portion **108***a*. Conversely, the term "disengaged" or "released", with reference to the release handle **110**, can refer to the position of the release handle **110** in which the telescoping portion **108***b* can be free to contract or expand with respect to the stationary portion **108***a*.

[**0057**] As further illustrated in **FIG. 5A**, an implementation of the release handle **110** comprises (i) an outer sheath **184***a,* which resides primarily inside the stationary portion **108***a* of the telescoping frame **110**; (ii) a spring bias **174** within the outer sheath **184***a;* (iii) one or more inner sheaths **184***b* extending from the outer sheath **184***a;* and (iv) a detent **178** that is biased by the spring **174**. When a user moves the release handle **110**, the user compresses the spring bias **174** as the user moves the handle **110** in toward the telescoping portion **108***b*. In so doing, the user extends the handle detent **178** from the one or more inner sheaths **184***b* into a respective cavity **180** in the telescoping portion **108***b*. The user locks the release handle **110** into position by rotating the handle, such that a shaft detent **182** slips into securing slot **176***a*.

[**0058**] A user can, of course, also disengage the release handle **110** so that the telescoping portion **108***b* can be repositioned with respect to the stationary portion **108***a*. As shown in **FIG. 5B**, for example, the release handle **110** is rotated and released (e.g., pulled or pushed) away from the stationary portion **108***a,* such that the handle detent **178** pulls out of the groove or cavity **180**. In one particular implementation, when a user rotates the release handle, the springs **174** become uncompressed, and force the handle **110** into an extended position. Once the handle is extended, the user then locks the handle **110** in the disengaged position by positioning shaft detent **182** into slot **176***b*. The telescoping portion **108***b* can then move freely with respect to the telescoping portion **108***a*. One will appreciate that the stability of such a locking mechanism is particularly important for a user performing relevant exercises such as on the exercise system **100**.

[**0059**] **FIGS. 6A-6B** and the following description provide greater detail regarding the resistance assembly **118** of strength training portion **106** (see also **FIGS. 1A-1B**). In particular, **FIG. 6A** illustrates a schematic overview of one resistance assembly **118** having cables **186** that couple the resistance assembly **118** to one or more exercise stations. **FIG. 6B** provides a more particular illustration of the resistance assembly **118** shown in **FIG. 6A**, further showing the one or more operations for the respective resistance and repetition counting parts.

[**0060**] In general, resistance assembly **118** is configured such that, when a user exerts a force by pulling one or more pull handles **142***a-d,* leg extension assembly **153** or another suitable exercise station, a respective cable **186** pulls against a resistance provided by resistance assembly **118**. Resistance assembly **118** may be employed as a self-contained assembly that may be portable to a variety of different exercise systems. Similar and alternative representations and operations of the depicted resistance assembly **118** are described in U.S. Pat. No. 6,685,607, filed on Jan. 10, 2003, entitled "EXERCISE DEVICE WITH RESISTANCE MECHANISM HAVING A PIVOTING ARM AND A RESISTANCE MEMBER", the entire contents of which are incorporated herein by reference.

[**0061**] As shown, resistance assembly **118** comprises: (i) a frame **143** configured to be mounted to an exercise device frame, such as frame **102**; (ii) a cable **186** having opposing ends that are configured to be coupled to one or more exercise stations, e.g., handles **142***a-b;* (iii) a pair of resilient resistance bands **196**, each coupled at a lower end thereof to frame **143**; (iv) a "primary" pivoting plate assembly **202** movably coupled below bands **196** to frame **143**; and (v) a threaded drive member **200** movably coupled to the pivoting plate assembly **202**. The illustrated resistance assembly **118** still further comprises: (vi) a cross beam **198** movably coupled to the threaded drive member **200** at one end via threaded pivoting member **198***a,* and, at an upper end, the cross beam **198** is coupled to another end of the resilient resistance bands **196**. The respective bands **196** are therefore connected to cross beam **198** in such a way that the respective bands **196** are moveable within respective slots **192***a* in frame **143**.

[**0062**] The illustrated resistance assembly **118** yet still further comprises: (vii) a motor **204** configured to selectively turn threaded drive member **200**; (viii) a "secondary" pivoting plate assembly **206** movably coupled to primary pivoting plate assembly **202**; and (ix) a series of pulleys mounted to frame **143** and the secondary pivoting plate assembly **206**, for receiving or transferring cable **186** therein. In general, cable **186** extends through one or more cavities in frame **143**, as shown in FIGS. **6**A-B, around the corresponding pulleys, and ultimately back into respective exercise handle stations coupled to frame **143** (e.g., handles **142***a-b*). Secondary cables may be coupled to handles **142***c-d* and to respective coupling joints **145***a-b* of cable **186**.

[**0063**] Upon movement of an exercise station, such as handle **124***a,* pivoting plate assembly **202** moves against resistance provided by resilient resistance bands **196**, as depicted by the extended broken lines shown in FIGS. **6**A-B. The resistance applied by bands resistance can be adjusted by adjusting the position of cross beam **198** along threaded drive member **200**. Such adjustment can occur by actuating drive motor **204** to thereby turn threaded drive member **200** within threaded pivoting member **198***a* of cross beam **198**. Threaded drive member **200** can thus be turned to move cross beam **198**, and hence change the angle against which force is applied to the resilient bands **196**, hence changing resistance. In at least one implementation, drive motor **204** is configured to rotate the threaded drive member **200** based on one or more electrical signals that may be received from console **144**, for example.

[**0064**] In particular, when the respective cable **186** moves upward (+x), pivoting plate assembly **202** is pulled in an upward, arcuate manner (+y) toward the resistance assembly frame **143**. In addition, the cross beam **198** rotates about the threaded pivoting member **198***a* **116***a,* which is in a fixed position set at least in part by the motor **204**. This movement of the cross beam **198** causes the flexible resilient bands **196** to stretch in a respective direction (+x) along the slots **192***a*. As shown, stretching of the resilient resistance bands **196** along the assembly slots **192***a* and **192***b* (+/−x) may be facilitated at least in part by resistance wheels **194***a-b*.

[0065] When the user releases the force, such as by releasing the pulling handle (e.g., **142***a*), the respective cable **186** moves back toward the resistance frame **111** (−x). This causes the pivoting plate assembly **202** to move in the reverse arcuate direction (−y). This further causes the cross beam **198** and resilient resistance bands **196** to move or contract in reverse directions (−x), such that the cables **186** and resilient bands **196** are in a relatively relaxed state.

[0066] One can appreciate, therefore, that the position of the cross beam **198** relative to the resistance assembly frame **143** has an effect on the angle at which the resilient resistance bands **196** are stretched. In particular, a smaller angle θ between the cross beam **198** and resilient resistance bands **196** provides a greater leverage angle (i.e., easier) to stretch the bands **196**, while a greater angle θ provides a lesser leverage angle (i.e., more difficult) to stretch the bands in the resistance member **118**. Thus, the resistance of the resistance assembly **118** in **FIGS. 6A-6B** can be adjusted by adjusting the resistance angle θ, which can be implemented by threaded pivoting member **198***a* along the threaded drive member **200**.

[0067] In particular, the assembly motor **204** is electrically coupled to the electronic console **144** via respective circuit wires (not shown). The motor **204** can be configured in one implementation to adjust the resistance of the resistance assembly **118** based on user input. For example, when the user selects an anaerobic resistance value, such as by selecting a resistance value at an input interface at the electronic console **144**, a respective electronic signal sent to the motor **204** causes the motor **204** to rotate the threaded drive member **200** a certain amount. The cross beam **198** thus moves along the threaded drive member **200** into a new position, which further causes the pivoting plate assembly **202** to be positioned closer to (or further from) the resistance assembly frame **143**.

[0068] **FIGS. 6A and 6B** further illustrate a repetition sensor **210** that may be used in accordance with the exercise system **100**. In particular, one implementation of a repetition sensor **210** comprises a voltage generator **218** having a frame **220** that is mounted to the resistance assembly **118**, a spring bias **216**, and a coupling member **212** (such as a ribbon) that is attached to the pivoting plate assembly **202**. When the pivoting plate assembly **202** moves with a user's exercise motion, the coupling member **212** moves a corresponding direction, causing the voltage generator **218** to send an electrical signal to the electronic console **144** through respective electrical wires **210**.

[0069] A more particular description of using a voltage generator as a repetition sensor to detect anaerobic repetitions is found in commonly-assigned U.S. patent application Ser. No. ______/______ (Workman Nydegger Attorney Docket No. 13914.970) of Kowallis, et al., filed on Aug. 11, 2004 via U.S. Express Mail Number EV 432 689 389 US, entitled "REPETITION SENSOR IN EXERCISE EQUIPMENT", the entire contents of which are incorporated herein by reference. Other sensors may be employed to sense various parameters of the components of the exercise system **100**, such as resistance at the strength training device **106**.

[0070] The exercise system **100** can also be configured to provide a user with a digital readout of the resistance level chosen. As shown in FIGS. 1A-B, and 6A-B, for example, the electronic console **144** can be connected to an anaerobic meter **210**, such as a repetition sensor **210**, for monitoring anaerobic exercises. The electronic console **144** can also be connected to a conventional aerobic meter (not shown) for monitoring aerobic exercise data. The electronic signals received from the anaerobic and aerobic meters (as well as, for example, the stabilizing handles **140**) then combines, processes, and/or displays data to the user at the electronic console **144**, as appropriate.

[0071] Furthermore, an implementation of the electronic console **144** comprises an input interface so that a user can control anaerobic or aerobic resistance, rates of exercise, and so forth. For example, a user can select a level of anaerobic resistance at an input interface at the electronic console **144**. The electronic console **144** can then interpret the user input, and send a respective electronic signal to the drive motor **204** of the resistance assembly **118**. After receiving the electronic signal, the motor **204** can then rotate the threaded drive member **200** until the resistance assembly **118** is set to the desired resistance. One will appreciate that similar mechanisms is used to control the resistance and exercise rate of the aerobic exercise system **140**. Accordingly, a wide variety of electronic console mechanisms and displays is employed within the context of the present invention.

[0072] **FIG. 7** illustrates an implementation of one electronic console **144** that can be used in an electronic console system in accordance with the present invention. In particular, the depicted electronic console **144** can be configured to have input and output displays for both a strength training device **106** and an elliptical device **104**. For example, with respect to aerobic exercise data, such an electronic console **144** comprises a counter interface **230** that displays incremental factual data such as calories burned, heart rate, speed of exercise time of exercise, and distance traveled. In one implementation, the user's heart rate is measured from sensors at handles **142***a-d,* etc. and/or sensors at stabilizing members **140**. A selectable "Display" button **230***a* provides a user with the ability to change which data (e.g., which value of time, speed, distance, etc.) are displayed to the user at a given point in time.

[0073] Although such incremental data is typically applicable for aerobic data, display interface **230** can be implemented with aerobic and anaerobic data, as appropriate. The depicted electronic console **144** further comprises one or more interfaces for providing interactive views and data options. For example, the electronic console **144** comprises a display interface **232** that may be used for indicating the type of program or workout routine in which the user is engaged. A selectable "Next" button **232***a* allows a user to scroll, for example, from one program option to the next.

[0074] In addition, the depicted electronic console **144** comprises a resistance interface **234** that allows a user to increase or decrease resistance of the strength training device **104** and the elliptical device **104**. For example, the illustrated electronic console **144** can also comprise a selectable decrement button **234***a* (e.g., "−") and a selectable increment button **234***b* (e.g., "+") for making the respective resistance adjustments. In one implementation, for example, input from the user at buttons **234***a* and **234***b* causes the electronic console **144** to send a respective data signal to the elliptical device **104**, thereby causing the aerobic resistor **164** to change positions (hence resistance).

[0075] The depicted electronic console **144** still further comprises additional display interfaces that may be particularly useful for anaerobic exercise data. For example, the electronic console **144** comprises a display interface **236** for setting, displaying, or modifying the number of exercise repetitions, and a similar display interface **238** for setting, displaying, or modifying the number of exercise repetition sets. In particular, selectable "−" button **236***a* and selectable "+" button **236***b* may be configured so that a user can set a target number of reps in a routine. Furthermore, selectable "=" button **238***a,* and selectable "+" button **238***b* may also be configured so that a user can set a target number of sets in a routine.

[**0076**] An exemplary electronic console **144**, therefore, can take input from the user via one or more selectable buttons (e.g., **230***a,* **232***a,* **234***a,* **234***b,* etc.), and send a respective data signal to the respective aerobic or anaerobic exercise system, as appropriate. Similarly, the electronic console **144** can take an input from the electronic console **144** and send a respective data signal to circuitry in the resistance assembly **118**, thereby causing the motor **204** to modify the position of the cross beam **198** relative to the resilient resistance bands **196**, hence change resistance. Of course, the electronic console **144** can also receive electronic signals from the elliptical exercise device **104**, the resistance assembly **118**, and the gripping handles **142***a-d,* and provide the user with relevant information through the relevant display interfaces **230**, **232**, **234**, **236**, and **238**.

[**0077**] One will appreciate that the foregoing description for an electronic console in an electronic console system can also be readily modified for multiple electronic consoles in an electronic console system. For example, an elliptical electronic console **144***a* (see **FIG. 1B**) can comprise display interfaces **230**, **230***a,* and **232**, while a strength training electronic console **144***b* (see **FIG. 1B**) can comprise display interfaces **232**, **232***a,* **234**, **234***a-b,* **236**, **236***a-b,* **238**, and **238***a-b*. In short, there are a variety of ways in which one or more electronic consoles can be configured to display data to a user at one or more positions on an exercise system **100**. Furthermore, there are a variety of ways in which each such electronic console can be configured to receive specific types of input from a user, or from a given exercise device (e.g., elliptical device **104**, strength training device **106**).

[**0078**] **FIG. 8** illustrates one embodiment of the present invention, in block diagram form, representing software modules and system components that are suitable for implementing an electronic console **144** that displays elliptical data and strength training data in an electronic console system. For example, an embodiment of an electronic console **144** comprises a connection to a power source **240**, and further includes a Device I/O (Input/Output) module **246** for receiving and transferring electronic signals. In particular, Device I/O module **246** comprises circuitry for two-way strength training communication **242** to the strength training exercise device **106**, and comprises circuitry for two-way elliptical communication **244** to the elliptical exercise device **104**. The electronic console **144** further comprises an interface for receiving data from sensors at, for example, the stabilizing members **140**, etc.

[**0079**] In addition, the exemplary electronic console **144** comprises a processing module **250** that includes, for example, a central processing unit **252** and any other necessary active and/or passive circuitry components to operate the exercise system **100**. For example, the processing module can comprise volatile or non-volatile memory, any magnetic or optical storage media, any capacitors and resistors, any circuit traces for transferring data between components, any status indicators such as light emitting diodes, and any other processing components and so forth as may be appropriate.

[**0080**] The electronic console **144** itself may also comprise additional input and output components such as an Ethernet connection port, a telephone connection port, audio in and out ports, optical in and out ports, wireless reception and transmission ports, and so forth. One will appreciate, therefore, that, for the purposes of convenience, not all components and circuit traces that may be used are shown in **FIG. 8**.

[**0081**] As shown, the exemplary electronic console **144** comprises a connection to a Display I/O module **260**. In particular, Display I/O module **260** comprises user-interactive display components such as a two-way strength training I/O component **262** for receiving and displaying strength training data (i.e., "anaerobic" data **254**) to and from a user. The Display I/O module **260** comprises a two-way combination I/O component **264** for receiving and displaying combination data **258** to and/or from the user, and a two-way elliptical I/O component **264** for displaying to the user (and/or receiving from the user) elliptical data (i.e., "aerobic data") **256**. In one implementation, combination I/O data includes data that is not uniquely strength training or elliptical-based information. For example, combination I/O data may include selection of a generalized workout routine at interface **232**, wherein the workout routine includes instructions to the electronic console **144** for both elliptical and strength training resistance levels.

[**0082**] In operation, the processing module **200** can receive anaerobic, or strength training, data **254**, aerobic, or elliptical, data **256**, and combination data **258** from any of the respective strength training device **106**, elliptical device **104**, and the user. For example, the strength training device **106** may send one or more electronic signals to the electronic console **144**. In one implementation, these signals indicate to the electronic console **144** the amount of strength training resistance, or identify the number of strength training exercise repetitions performed, and so forth.

[**0083**] In addition, sensors in, for example, the stabilizing handles **140**, can send data signals to the electronic console **144** that can indicate the user's pulse rate count. Similarly, the elliptical system **104** may send one or more respective electronic signals to the electronic console **144**, such that the electronic console **144** can identify the amount of elliptical resistance, the number of revolutions of the flywheel **124**, the speed of the flywheel **124**, and so forth.

[**0084**] In addition to data received from the exercise portions **104**, **106**, and any other sensors, etc., the processing module **250** can also receive user input through the console's **144** interactive displays. This user-provided input can include selections for change in resistance, a change in speed, a change in incline, a change in exercise programs, and so forth. The processing module **250** can also receive user data such as the user's weight, age, height, and any other relevant data that may be useful for providing the user with accurate feedback, or for modulating the duration and intensity of a given workout.

[**0085**] When the processing module **250** receives appropriate data, a CPU **252** at the processing module **250** can then execute instructions. For example, the CPU can combine various data such as age, heart rate, exercise speed, weight, resistance, and other such parameters to provide the user with an accurate depiction of the calories burned, distance traveled, and so forth. In some cases, the CPU **252** may simply report the received data directly to a user display, and thus formats received data signals so that they can be read at a respective display. In other cases, the CPU **252** may simply calculate the data using one or more equations, as appropriate, before providing the user with a display value. In still other cases, the CPU **252** may simply format data received from a user (or surmised from a workout), and send the formatted data as a respective electronic signal to a motor at an exercise portion (e.g., **104**, **106**), and so forth.

[**0086**] One will appreciate, of course, that an electronic console system configured to implement multiple electronic consoles (e.g., **144***a,* **144***b,* etc.) may vary the implementation of the foregoing software modules and connection interfaces, as appropriate. For example, an electronic console **144***a* configured to display elliptical data may comprise elliptical communication circuitry **244**, aerobic I/O component **266**, and corresponding processing modules. By contrast, an electronic console **144***b* configured to display strength training data may comprise strength training circuitry **242**, as well as the anaerobic I/O component **262**, and corresponding processing modules.

[**0087**] Accordingly, the various implementations of the present invention enable a user to readily perform a wide range of elliptical and strength training exercises that are an important part of a workout routine. In particular, the various implementations of the present invention enable a user to perform a wide variety of strength training and elliptical exercises in a relatively small space since the exercise system is compacted or expanded by virtually any user. In addition, electronic data options provide a user with the ability to monitor and/or manipulate data for a wide range of strength training and elliptical exercises.

[**0088**] In addition, one of ordinary skill will appreciate that any number of strength training resistance systems such as those related to weight stacks, coil springs, shocks, elastomeric bands, resistance rods or bows or the like may be substituted for the present cable and pulley resistance system **106** within the context of the invention. Furthermore, any number of elliptical exercise systems such as steppers, gliders, skiers, striders, treadmills, exercise bikes, and so forth, can also be implemented in place of the depicted elliptical exercise system **104** within the context of the invention. Thus, an exercise system **100** of the present invention comprises (i) a first exercise device, e.g., elliptical device **104** coupled to frame **102** and (ii) a second exercise device e.g., strength training system **106** coupled to the frame. Frame **102** is configured such that at least a portion of the first exercise device can be compacted and expanded with respect to at least a portion of the second exercise device.

[**0089**] Another advantage of system **100** is that strength training exercise device **106** is operable independently from elliptical exercise device **104**. Thus, one user may use elliptical device **104** while a different user uses strength training device **106**. Another advantage of system **100** is that it features an elliptical exercise device, i.e., elliptical device **104**, linked to an anaerobic exercise device **106** through frame **102**, wherein at least a portion of the elliptical exercise device is movably coupled to at least a portion of the strength training device, such that the exercise system is capable of being moved from a compact position to an extended position. For example, it may be more convenient for a first user to use the strength training device **106**, and for a second user to use the elliptical exercise device **104**, while system **100** is in an extended position.

[**0090**] The present invention has been described with continued reference to a telescoping frame **102**. The telescoping frame, however, is simply one example of a multi-part frame which acts as an implementation for coupling two exercise devices in this manner. As shown in **FIGS. 9A and 9B**, for example, telescoping frame **102** is replaced by a pivoting frame, which is another example of a multi-part frame. In particular, one portion of an exercise device, such as the crank of an elliptical exercise device, may be coupled to a primarily stationary portion **108***c* of the pivoting frame, while a second exercise device may be coupled to a mobile portion **108***d* that swings about a pivot point **108***e*.

[**0091**] In particular, **FIG. 9A** shows that a portion of the elliptical device **104** can be tilted away from the strength training device **106** for performing elliptical exercises. By contrast, **FIG. 9B** shows that the portion of the elliptical device **104** can be tilted toward the strength training device **106**, such as when performing strength training exercises. As such, one will appreciate that there are a number of ways for providing a multi-part frame having multiple exercise devices thereon.

[**0092**] Exercise system **100** disclosed herein may optionally be referred to as comprising: (i) an elliptical exercise assembly, comprising: (A) a frame **102**; (B) a crank **120** movably coupled to frame **102**; and (C) first and second foot supports **122***a-b* movably coupled to the crank **120**; and (ii) a second exercise device (e.g., strength training device **106**) coupled to the elliptical exercise assembly. At least a portion of the elliptical exercise assembly can be movably positioned closer to and further away from at least a portion of the second exercise device.

[**0093**] It should therefore be appreciated that the present invention may be embodied in other forms without departing from its spirit or essential characteristics. As properly understood, the preceding description of specific embodiments is illustrative only and in no way restrictive. The scope of the invention is, therefore, indicated by the appended claims as follows.

We claim:

1. An exercise system comprising:

a frame;

a first exercise device coupled to the frame, the first exercise device comprising an elliptical exercise device; and

a second exercise device coupled to the frame.

2. An exercise system as recited in claim 1, wherein the second exercise device comprises an anaerobic exercise device.

3. An exercise system as recited in claim 2, wherein the second exercise system comprises a strength training exercise device that is operable independently from the elliptical exercise device.

4. An exercise system as recited in claim 3, wherein the second exercise device comprises a cable and pulley system coupled to a resistance mechanism.

5. An exercise system as recited in claim 4, wherein the resistance mechanism comprises at least one resilient band.

6. An exercise system as recited in claim 1, wherein the frame is a multi-part frame.

7. An exercise system as recited in claim 6, wherein the frame is a telescoping frame.

8. An exercise system as recited in claim 6, wherein the frame comprises a stationary portion and a telescoping portion.

9. An exercise system as recited in claim 1, wherein the frame is configured such that at least a portion of the first exercise device is compactible or expandable with respect to at least a portion of the second exercise device.

10. An exercise system as recited in claim 1, wherein the frame comprises a padded bench on which a user can sit while performing exercises.

11. An exercise system as recited in claim 1, wherein the frame comprises a padded bench against which a user can lean while performing exercises.

12. An exercise system comprising:

(i) a first exercise device comprising an elliptical exercise assembly, the elliptical exercise assembly comprising:

(A) a frame;

(B) a crank movably coupled to the frame;

(C) first and second foot supports movably coupled to the crank; and

(ii) a second exercise device coupled to the elliptical exercise assembly.

13. An exercise system as recited in claim 12, wherein the second exercise device is coupled to the frame of the elliptical exercise assembly.

14. An exercise system as recited in claim 12, wherein the second exercise device is operable independently from the elliptical exercise assembly.

15. An exercise system as recited in claim 12, wherein the second exercise device is a strength training exercise device.

16. An exercise system as recited in claim 12, wherein at least a portion of the elliptical exercise assembly is configured to be movably positioned closer to and further away from at least a portion of the second exercise device.

17. An elliptical exercise device having a compacted position and an extended position, comprising:

a multi-part frame, wherein a movable portion of the frame is movable with respect to a stationary portion of the frame; and

a elliptical exercise device comprising a crank, wherein the crank is coupled to the movable portion of the frame.

18. An elliptical exercise device as recited in claim 17, wherein the frame is a telescoping frame, comprising a telescoping portion and the stationary portion.

19. An elliptical exercise device as recited in claim 17, wherein the frame is a pivoting frame, comprising a pivoting portion and the stationary portion.

20. An elliptical exercise device as recited in claim 17, wherein the elliptical exercise device comprises a crank movably coupled to the movable portion of the frame, and first and second foot supports movably coupled to the crank.

21. An elliptical exercise device as recited in claim 17, further comprising a strength training exercise device coupled to the frame.

22. An elliptical exercise device as recited in claim 17, wherein the elliptical exercise device comprises at least one flywheel for facilitating elliptical motion, and a resistance device coupled to the at least one flywheel.

23. An elliptical exercise device as recited in claim 22, further comprising first and second foot supports coupled to the at least one flywheel, wherein the first and second foot supports engage the flywheel to produce elliptical motion.

24. An elliptical exercise device as recited in claim 17, wherein the frame comprises a padded bench on which a user can sit while performing exercises.

25. An exercise system configured to enable anaerobic exercise motion by a user and aerobic exercise motion by a user, the exercise system having a compact position and an extended position, the exercise system comprising:

an aerobic exercise device; and

an anaerobic exercise device linked to the aerobic exercise device, wherein at least a portion of the aerobic exercise device is movably coupled to at least a portion of the anaerobic device, such that the exercise system is capable of being moved from a compact position to an extended position.

26. An exercise device as recited in claim 25, wherein the aerobic exercise device comprises a padded bench mounted thereon, on which a user can sit while performing exercises with the anaerobic exercise device.

27. An exercise system as recited in claim 25, wherein the exercise system is configured such that the aerobic exercise device is configured to be used when the exercise system is in an extended position, and the anaerobic exercise device is configured to be used when the exercise system is in a compact position.

28. An exercise system as recited in claim 28, wherein the exercise system is configured such that the anaerobic exercise device operates independently from the aerobic exercise device.

29. An exercise system as recited in claim 28, wherein at least a portion of the aerobic device is mounted on one portion of a movable frame and wherein at least a portion of the anaerobic exercise device is mounted on another portion of the movable frame.

30. An exercise system as recited in claim 29, wherein the movable frame comprises a telescoping frame and wherein a crank of the aerobic device is coupled to one portion of the telescoping frame, and a resistance system of the anaerobic device is coupled to another portion of the telescoping frame.

31. An exercise system comprising:

a telescoping frame;

a first exercise device coupled to one portion of the telescoping frame, the first exercise device comprising an elliptical exercise device comprising (A) a crank movably coupled to the frame; and (B) first and second foot supports movably coupled to the crank; and a second exercise device coupled to another portion of the telescoping frame, the second exercise device comprising a strength training device, the strength training device comprising (A) a resistance assembly coupled to the frame; and (B) an exercise station linked to the resistance assembly, wherein the first exercise device is operable independently from the second exercise device, such that the telescoping frame is selectively movable from a compacted position to an extended position, and such that a user can selectively perform aerobic or anaerobic exercises on the exercise system.

32. An electronic console having one or more circuitry components for use in combination with anaerobic and aerobic exercise devices, the electronic console comprising:

one or more processing modules configured to process electronic data signals received from an anaerobic exercise device and an aerobic exercise device;

one or more first display interfaces for displaying anaerobic exercise data relayed from the one or more processing modules; and

one or more second display interfaces for displaying aerobic exercise data relayed from the one or more processing modules.

33. The electronic console as recited in claim 32, further comprising an input interface for adjusting one or more of an adjustable anaerobic resistance member and an adjustable aerobic resistance member.

34. The electronic console as recited in claim 32, wherein the aerobic exercise data comprise one or more of: (i) time spent exercising, (ii) calories burned, (iii) heart rate during exercise, (iv) exercise speed, and (v) exercise distance.

35. The electronic console as recited in claim 32, wherein the anaerobic data comprise at least one of: (i) a number of repetitions desired, (ii) a number of repetitions performed, (iii) a number of sets desired, and (iv) a number of sets performed.

36. The electronic console as recited in claim 32, wherein the anaerobic exercise device and the aerobic exercise device are on the same exercise system.

37. An exercise machine having at least one electronic console system, the exercise machine configured to enable anaerobic and aerobic exercises, comprising:

a frame having a first exercise device and a second exercise device coupled thereto;

a first electronic display interface configured to display electronic signals from the first exercise device; and

a second electronic display interface configured to display electronic signals from the second exercise device.

38. An exercise system as recited in claim 37, wherein the frame is a multi-part frame having a stationary portion, and a telescoping portion or a pivoting portion.

39. An exercise system as recited in claim 37, wherein the first and second electronic display interfaces are both linked to at least one of the first and second exercise devices of the exercise system.

40. An exercise system as recited in claim 37, wherein the first electronic display interface is configured to display aerobic exercise instructions to a user; and wherein the second electronic display interface is configured to display anaerobic exercise instructions to the user.

41. An exercise system as recited in claim 37, wherein the first electronic display interface and the second electronic display interface display exercise data on a single electronic console.

42. An exercise system as recited in claim 37, wherein the first electronic display interface and the second electronic display interface display exercise data a plurality of electronic consoles.

43. An exercise system as recited in claim 37, wherein the first electronic display interface and the second electronic display interface provide a user with workout instructions to perform circuit training on the exercise machine.

44. An exercise system as recited in claim 43, wherein the workout instructions to the user comprise at least one of (i) an anaerobic activity at the first exercise device; and (ii) an aerobic activity at the second exercise device.

45. An exercise system as recited in claim 44, wherein the first exercise device is coupled to a movable portion of the frame; and wherein the second exercise device is coupled to a stationary portion of the frame.

46. An exercise machine configured to enable a user to engage in aerobic and anaerobic exercises, comprising:

an exercise apparatus configured to enable a user to engage in aerobic and anaerobic exercises; and

an electronic console system coupled to the exercise apparatus, the electronic console system comprising:

one or more processing modules configured to process electronic data signals;

one or more first display interfaces for displaying anaerobic exercise data relayed from the one or more processing modules; and

one or more second display interfaces for displaying aerobic exercise data relayed from the one or more processing modules.

47. The exercise machine as recited in claim 46, wherein the exercise apparatus comprises a movable member.

48. The exercise machine as recited in claim 46, wherein the exercise apparatus comprises an anaerobic exercise device and an aerobic exercise device.

49. The exercise machine as recited in claim 46, wherein the exercise apparatus comprises a multi-part frame having a stationary portion, and a telescoping portion or a pivoting portion.

* * * * *

Docket Number 13-017.12.01 (59665.0445)

TITLE

Push Actuated Positional Adjustment of Strength Machines

BACKGROUND

[0001] While there are numerous exercise activities that one may participate in, exercise may be broadly broken into the categories of aerobic exercise and anaerobic exercise. Aerobic exercise generally refers to activities that substantially increase the heart rate and respiration of the exerciser for an extended period of time. This type of exercise is generally directed to enhancing cardiovascular performance. Such exercise usually includes low or moderate resistance to the movement of the individual. For example, aerobic exercise includes activities such as walking, running, jogging, swimming or bicycling for extended distances and extended periods of time.

[0002] Anaerobic exercise generally refers to exercise that strengthens skeletal muscles and usually involves the flexing or contraction of targeted muscles through significant exertion during a relatively short period of time and/or through a relatively small number of repetitions. For example, anaerobic exercise includes activities such as weight training, push-ups, sit-ups, pull-ups or a series of short sprints.

[0003] To build skeletal muscle, a muscle group is contracted against resistance. The contraction of some muscle groups produces a pushing motion, while the contraction of other muscle groups produces a pulling motion. A cable machine is a popular piece of exercise equipment for building those muscle groups that produce pulling motions. A cable machine often includes a cable with a handle connected to a first end and a resistance mechanism connected to a second end. A midsection of the cable is supported with at least one pulley. To move the cable, a user pulls on the handle with a force sufficient to overcome the force of the resistance mechanism. As the cable moves, the pulley or pulleys direct the movement of the cable and carry a portion of the resistance mechanism's load.

[0004] One type of cable machine is disclosed in U.S. Patent No. 7,608,024 issued to Scott Sechrest. In this reference, a multiple exercise performance or positioning apparatus comprising a generally upright stationary frame on which is mounted an elongated arm mechanism which is mounted on a pivot mechanism, the arm mechanism extending from a proximal end to a distal end relative to the frame, the pivot mechanism enabling pivoting of the arm mechanism such that the distal end of the arm mechanism is adjustably movable between positions of variable distance away from the frame, wherein a cable mechanism is mounted around one or more pulleys, the cable mechanism having a first end interconnected to a handle mechanism which is mounted at the distal end of the elongated arm mechanism, the cable mechanism being interconnected to a weight resistance mechanism such that a user may grasp and pull the handle mechanism against an opposing force exerted by the weight resistance mechanism through the cable mechanism. Other types of cable machines are described in U.S. Patent No. 7,815,552 issued to Ryan R. Dibble and U.S. Patent Publication No. 2009/0170668 issued to Raymond Giannelli.

SUMMARY

[0005] In one aspect of the disclosure, an exercise machine includes an adjustable joint comprising a first part and a second part that are shaped to rotate with respect to each other.

[0006] In one or more other aspects that may be combined with any of the aspects herein, may further include that when an orientation between the first part and the second part changes a position of a user contact feature also changes.

[0007] In one or more other aspects that may be combined with any of the aspects herein, may further include a locking mechanism positioned to lock the first part and the second part together.

[0008] In one or more other aspects that may be combined with any of the aspects herein, may further include that the moving mechanism is positioned to interlock the first part and the second part in a locking direction and to release the first part from the second part in a release direction.

[0009] In one or more other aspects that may be combined with any of the aspects herein, may further include that when the first part and the second part are interlocked at least two first part features are interlocked with at least two second part features simultaneously.

[0010] In one or more other aspects that may be combined with any of the aspects herein, may further include that the first part and the second part are connected with a central

pivot shaft shaped to allow the first part and the second part to rotate about a central axis with respect to each other.

[0011] In one or more other aspects that may be combined with any of the aspects herein, may further include that the locking mechanism is incorporated into the central pivot shaft.

[0012] In one or more other aspects that may be combined with any of the aspects herein, may further include that the locking mechanism comprises a spring that forms a spring force in the locking direction.

[0013] In one or more other aspects that may be combined with any of the aspects herein, may further include that the at least two first part features are protrusions and the at least two second part features are receptacles that are spaced receive the protrusions.

[0014] In one or more other aspects that may be combined with any of the aspects herein, may further include that the receptacles are formed in a periphery of the second part.

[0015] In one or more other aspects that may be combined with any of the aspects herein, may further include that the receptacles are formed in a face of the second part.

[0016] In one or more other aspects that may be combined with any of the aspects herein, may further include that the receptacles are formed in a substantially circular arrangement.

[0017] In one or more other aspects that may be combined with any of the aspects herein, may further include that the first part and the second part are plates that face one another.

[0018] In one or more other aspects that may be combined with any of the aspects herein, may further include that the locking mechanism incorporates a cam assembly.

[0019] In one or more other aspects that may be combined with any of the aspects herein, may further include that the at least two second part features are grooves that are formed along a width of the second part.

[0020] In one or more other aspects that may be combined with any of the aspects herein, may further include that the locking mechanism is arranged to release the first part in response to a pushing action by a user.

[0021] In one or more other aspects that may be combined with any of the aspects herein, may further include that the adjustable joint is formed in a mechanical linkage that connects a resistance mechanism to a user contact feature.

[0022] In one or more other aspects that may be combined with any of the aspects herein, may further include that the mechanical linkage between the resistance mechanism and the user contact feature are connected with a cable that is routed through the adjustable joint.

[0023] In one or more other aspects that may be combined with any of the aspects herein, may further include that the locking direction is aligned with a pull force generated when a user pulls against the resistance mechanism.

[0024] In one or more other aspects that may be combined with any of the aspects herein, may further include a mechanical linkage that connects a resistance mechanism to the user contact feature.

[0025] In one or more other aspects that may be combined with any of the aspects herein, may further include that the adjustable joint comprises a first plate and a second plate that are connected with a central pivot shaft shaped to allow the first plate and the second plate to rotate with respect to each other such that when an orientation between the first plate and the second plate changes a position of the handle also changes.

[0026] In one or more other aspects that may be combined with any of the aspects herein, may further include a locking mechanism positioned to move at least one of the first plate and the second plate.

[0027] In one or more other aspects that may be combined with any of the aspects herein, may further include that the locking mechanism being positioned to interlock the first plate and the second plate in a locking direction and to release the first plate from the second plate in a release direction.

[0028] In one or more other aspects that may be combined with any of the aspects herein, may further include that when the first plate and the second plate are interlocked at least two protrusions of the first plate are inserted into at least two receptacles of the second plate simultaneously.

[0029] In one or more other aspects that may be combined with any of the aspects herein, may further include that the mechanical linkage between the resistance mechanism and the handles are connected with a cable that is routed through the adjustable joint.

[0030] In one or more other aspects that may be combined with any of the aspects herein, may further include that the locking mechanism comprises a spring that forms a spring force in the locking direction.

[0031] In one or more other aspects that may be combined with any of the aspects herein, may further include that the locking mechanism is arranged to release the first part in response to a pushing action by a user.

[0032] In one or more other aspects that may be combined with any of the aspects herein, may further include a mechanical linkage that connects a resistance mechanism to at least one handle.

[0033] In one or more other aspects that may be combined with any of the aspects herein, may further include that the mechanical linkage includes a cable that is routed through an adjustable joint.

[0034] In one or more other aspects that may be combined with any of the aspects herein, may further include that the adjustable joint comprises a first plate and a second plate that are connected with a central pivot shaft shaped to allow the first plate and the second plate to rotate with respect to each other such that when an orientation between the first plate and the second plate changes, a position of the at least one handle also changes.

[0035] In one or more other aspects that may be combined with any of the aspects herein, may further include a locking mechanism that is arranged to move at least one of the first plate and the second plate.

[0036] In one or more other aspects that may be combined with any of the aspects herein, may further include that the locking mechanism is positioned to interlock the first plate and the second plate in a locking direction and to release the first plate from the second plate in a release direction.

[0037] In one or more other aspects that may be combined with any of the aspects herein, may further include that the locking mechanism comprises a spring that forms a spring force in the locking direction.

[0038] In one or more other aspects that may be combined with any of the aspects herein, may further include that when the first plate and the second plate are interlocked at least two protrusions of the first plate are inserted into at least two receptacles of the second plate simultaneously.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] The accompanying drawings illustrate various embodiments of the present apparatus and are a part of the specification. The illustrated embodiments are merely examples of the present apparatus and do not limit the scope thereof.

[0040] **FIG. 1** illustrates a front perspective view of an example of an exercise machine in accordance with the present disclosure.

[0041] **FIG. 2** illustrates a close up view of an adjustable joint of the exercise machine of FIG. 1.

[0042] **FIG. 3** illustrates an exploded view of the adjustable joint of FIG. 1.

[0043] **FIG. 4** illustrates a side view of an example of an adjustable joint in a locked position in accordance with the present disclosure.

[0044] **FIG. 5** illustrates a side view of an example of a locking mechanism in a released position in accordance with the present disclosure.

[0045] **FIG. 6** illustrates a side view of an alternative example of a locking mechanism with a cam assembly in accordance with the present disclosure.

[0046] **FIG. 7** illustrates a cross sectional view of an alternative example of a locking mechanism in accordance with the present disclosure.

[0047] **FIG. 8** illustrates a perspective view of an alternative example of a component of a locking mechanism in accordance with the present disclosure.

[0048] **FIG. 9a** illustrates a side view of an example of a plate of a locking mechanism in accordance with the present disclosure.

[0049] **FIG. 9b** illustrates a side view of an alternative example of a plate of a locking mechanism in accordance with the present disclosure.

[0050] **FIG. 9c** illustrates a side view of an alternative example of a plate of a locking mechanism in accordance with the present disclosure.

[0051] **FIG. 10a** illustrates a side view of an alternative example of a plate of a locking mechanism in accordance with the present disclosure.

[0052] **FIG. 10b** illustrates a side view of an alternative example of a plate of a locking mechanism in accordance with the present disclosure.

[0053] **FIG. 10c** illustrates a side view of an alternative example of a plate of a locking mechanism in accordance with the present disclosure.

[0054] **FIG. 10d** illustrates a side view of an alternative example of a plate of a locking mechanism in accordance with the present disclosure.

[0055] **FIG. 11** illustrates a side view of an alternative example of a locking mechanism in accordance with the present disclosure.

[0056] **FIG. 12** illustrates a side view of an alternative example of a locking mechanism in accordance with the present disclosure.

[0057] **FIG. 13** illustrates a front perspective view of an example of a pull exercise machine in accordance with the present disclosure.

[0058] **FIG. 14** illustrates a front perspective view of an example of an exercise machine in accordance with the present disclosure.

[0059] Throughout the drawings, identical reference numbers designate similar, but not necessarily identical, elements.

DETAILED DESCRIPTION

[0060] Building muscle can be enhanced by varying the angle at which a weight a moved. For example, on a cable machine, a different group of muscles is worked when the user is pulling the cable upwards verses pulling the cable downwards. Likewise, a user can target different muscles groups when the user varies the vertical height of the user's arms. For example, the user can grip a handle bar by positioning the right end of the handle bar to a higher positions than a left end of the handle bar. As the user pulls back the muscles worked on the right side of the user will be different than a group of muscles worked on the left side of the user. The user can switch the vertical heights of the handle bar's ends such that the left end of the handle bar is positioned to the height previously occupied by the right end of the handle bar. Likewise, the right end of the handle bar can be positioned to the vertical height previously occupied by the left end of the handle bar. As the user pulls the handle bar back with the left end higher than the left end against a force generated by the resistance mechanism, the user works the corresponding different muscle groups.

[0061] The principles described in the present disclosure provide a quick and efficient mechanism to change an angle of a handle bar without causing the user to manually remove a pin, rotate the handle bar, and reinsert the pin while maintaining the handle bar in the desired angle. Such principles allow the user to merely push a cross bar away from the user to release the cross bar from a locked state, rotate the cross bar to a desired angle while the cross bar is released, and return the cross bar to the lock state when the cross bar is at the desired angle.

[0062] For the purposes of the present disclosure, the term “locking direction” is any appropriate direction of the movement of either the first part or the second part of the locking mechanism that causes the first part and the second part to interlock. For the purposes of the present disclosure, the term “release direction” is any appropriate direction of the movement of either the first part or the second part of the locking mechanism that causes the second part to be free from the first part.

[0063] For purposes of the present disclosure, the term “user contact feature” may include any feature that may come into contact with a user to operate the exercise machine. Such a user contact feature may include, but is not limited to handles, cross bars, press bars, back supports, legs grips, hand grips, pads, other types of user contact features, or combinations thereof. Further, for purposes of the present disclosure, the term “mechanical linkage” may include any appropriate type of linkage that connects the user contact feature with the resistance mechanism. Such mechanical linkages include cables, arms, cross bars, rods, other types of mechanical linkages, or combinations thereof.

[0064] Particularly, with reference to the figures, FIGS. 1-2 depict a pull exercise machine 10 that includes a tower 12 supported by a base 14. In the example of FIGS. 1-2, the base includes three legs 16; however, any number of legs may be used in accordance with the present disclosure. A cross bar 18 is connected to the tower 12. A first handle 20 is connected to a first end 22 of the cross bar 18, and a second handle 24 is connected to a second end 26 of the cross bar 18. Each handle 20, 24 is connected to a cable 28 that is routed through or otherwise supported by the cross bar 18 to a resistance mechanism that is supported by the tower 12.

[0065] As the user pulls on the handles 20, 24, the cable 28 move against a force generated by the resistance mechanism, which resists cable movement. The resistance mechanism may be integrated into a cavity formed in the tower 12 or the resistance mechanism may be attached to an outside surface of the tower 12. In some examples, the resistance mechanism is a magnetic resistance mechanism. In other examples, the resistance mechanism includes a stack of weights. In yet other examples, the resistance mechanism includes a pulley resistance type mechanism, flywheel resistance mechanism, a braking mechanism, elastomeric resistance mechanism, another type of resistance mechanism, or combinations thereof.

[0066] The cross bar 18 may be attached to the tower 12 at an adjustable joint 30. In some examples, the height 32 of the cross bar 18 is adjustable. The height 32 of the cross bar 18 may be adjusted by sliding the cross bar 18 along a length 34 of the tower 12. Any appropriate type of mechanism may be used to slide-ably lock or slide-ably release the cross bar 18 from the tower 12 to adjust the cross bar's height 32. For example, a screw clamp, release button, or another mechanism may be used to adjust the height 32 of the cross bar 18.

[0067] The azimuth of the cross bar 18 may also be adjusted. The adjustable joint 30 may include a locking mechanism 36 that provides an easy and convenient mechanism for adjusting the azimuth of the cross bar. In the examples of FIGS 1-2, the cross bar 18 is positioned such that the cross bar 18 is perpendicular to the tower 12. However, the adjustable joint 30 may allow the cross bar to be adjusted to any appropriate azimuthal position. Appropriate azimuthal positions may include rotating the cross bar 18 to be substantially parallel with the tower 12. In other examples, the cross bar 18 and the tower 12 may form an angle between zero and 90 degrees. In examples where the cross bar 18 is substantially perpendicular with the tower 12, the handles 20, 24 at the first and second ends 22, 26 of the cross bar 18 will be at approximately the same height. However, when the cross bar 18 and the tower 12 form any angle that is different than 90 degrees, the height of the first and second handles 20, 24 will be different providing the user an advantage of working targeted muscle groups.

[0068] FIG. 3 illustrates an exploded view of the adjustable joint of FIG. 1. In this example, the locking mechanism 36 of the adjustable joint 30 has a first plate 38, a second plate 40, a central pivot shaft 42, and a compression spring 44. The first plate 38, second plate 40, central pivot shaft 42, and the compression spring 44 share a common central axis 46. The first plate 38 and the second plate 40 are loaded onto the central pivot shaft 42. The compression spring 44 is also loaded onto the central pivot shaft 42 such that the compression spring 44 pushes the second plate 40 towards the first plate 38.

[0069] The first plate 38 includes multiple features, such as receiving holes 48 that are formed through the thickness 50 of the first plate 38. The second plate 40 also includes a central hole 52 such that the first plate 38 can be connected to the central pivot shaft 42. The first plate 38 may be rigidly secured to the central pivot shaft 42 with a weld, fastener, thread form, or another type of rigid connection. In alternative examples, the first plate 38 is integrally formed with the central pivot shaft 42 and they are formed as a single piece. The holes 48 formed in the first plate 38 are arranged in any appropriate arrangement. In the example of FIG.3, the holes 48 are arranged such that they are spaced equidistance from one another near the periphery of the first plate 38.

[0070] The second plate 40 also has another central hole 54 to receive the central pivot shaft 42. The central hole 54 of the second plate 40 is shaped such that the second plate can rotate around the central pivot shaft 42 about the central axis 46. The second plate 40 includes multiple features, such as protrusions 56 that are spaced to be inserted into at least some of the holes 48 formed in the first plate 38. In some examples, there is a corresponding protrusion 56 of the second plate 40 for each of the holes 48 in the first plate 38. In alternative examples, there is just two or more protrusions 56 that can be inserted into the holes 48 of the first plate 38. The arrangement of the holes 48 of the first plate 38 and the protrusions 56 of the second plate 40 are such that the second plate 40 can be situated in multiple azimuthal positions about the central pivot shaft 42 and/or central axis 46 with respect to the first plate 38 when the protrusions 56 are inserted into the holes 48.

[0071] The second plate 40 is attached to the cross bar 18. As the angular position of the cross bar 18 changes based on the user's preferences, the movement of the cross bar 18 will change the position of the second plate 40 when the second plate's protrusions 56 are not inserted into the holes 48 of the first plate 38. When the protrusions 56 are inserted into the first plate's holes 48, the rotation of the cross bar 18 with respect to the first plate 38 will be locked. Thus, for a user to change the azimuth of the cross bar 18 with respect to the first plate 38, the user may move the cross bar 18 in a direction such that the second plate 40 moves away from the first plate 38 to release the second plate 40 from the first plate 38. The user may then orient the cross bar 18 to any desired azimuthal position about the central pivot shaft 42. When the desired azimuthal position is reached, the cross bar 18 may be moved in a direction towards the first plate 38 such that the protrusions 56 of the second plate interlock with the holes 48 of the first plate 38. When the first and second plate 38, 40 are interlocked, the cross bar 18 is rotationally locked in place.

[0072] The compression spring 44 is situated about the central pivot shaft 42 such that the compression spring 44 creates a spring force that pushes the second plate 40 towards the first plate 38. With such an arrangement, the compression spring 44 causes the first plate 38 and the second plate 40 to be interlocked by default. However, the spring force is not strong enough that a user cannot overcome the force by pushing on the cross bar to release the second plate 40 from the first plate 38 when adjusting the cross bar's orientation.

[0073] While this example has been described with reference to a specific mechanism that urges the second plate 40 towards the first plate 38, any appropriate mechanism may be used to create a force that moves the second plate 40 along a length of the central shaft towards the first plate 38. For example, a tension spring, a suction device, gravity, another mechanism, or combinations thereof may be used to create such a force.

[0074] Further, while this example has been described with specific reference to the second plate 40 being attached to the cross bar 18, in alternative examples the cross bar 18 is attached to the first plate 38. Further, in alternative examples, the plate that moves with the cross bar 18 may include protrusions, holes, or combinations thereof.

[0075] Either the first plate 38 or the second plate 40 may have any appropriate shape. For example, the first plate may be square, rectangular, circular, another type of shape, of combinations thereof. Additionally, in some examples, either the holes 48 or the protrusions 56 are formed directly into the cross bar 18. In examples, where a plate is rigidly attached to the cross bar 18, the rigid attachment may be accomplished through any appropriate manner. For example, the plate may be welded, bonded, fastened, crimped, or otherwise rigidly connected to the cross bar 18.

[0076] FIG. 4 illustrates a cross sectional view of an example of a locking mechanism 36 in a locked position in accordance with the present disclosure. In this example, the second plate 40 is pushed by the compression spring 44 into the first plate 38 such that the protrusions 56 and holes 48 interlock. FIG. 5 illustrates a cross sectional view of an example of a locking mechanism 36 in a released position in accordance with the present disclosure. In this example, there is a gap 58 between the first plate 38 and the second plate 40. The width of the gap 58 is longer than the length the protrusions 56 such that the protrusions 56 are pulled out of the holes 48 in the first plate 38.

[0077] Any appropriate type of part in the locking mechanism 36 may be used in accordance with the principles described in the present disclosure. For example, the parts of the locking mechanism 36 may include the first plate 38, the second plate 40, a cam assembly 59, a conical shaped part, a part of another shape, or combinations thereof. Further, any appropriate features of the first part 60 or the second part 68 may be used in accordance with the principles described in the present disclosure. For example, the features may be features that allow the first part 60 and the second part 68 to be interlocked. Such features may include holes, grooves, recesses, protrusions, ridges, bumps, divots, edges, other types of features, or combinations thereof. Additionally, the features may be arranged on either the first part 60 or the second part 68 in any appropriate arrangement. For example, the features may be arranged in a substantially circular arrangement, a substantially triangular arrangement, a substantially square arrangement, a substantially rectangular arrangement, another type of arrangement, or combinations thereof. In some examples, each of the feature of the first part 60 mirrors features of the second part 68. However, in alternative examples, there is an unequal distribution of features between the first part 60 and the second part 68. In such examples, some of the features of either the first part 60 or the second part 68 will not be interlocked while some of the features are interlocked.

[0078] FIG. 6 illustrates a cross sectional view of an alternative example of a locking mechanism 36 incorporating a cam assembly 59 in accordance with the present disclosure. In this example, the cam assembly 59 includes a first part 60 that is spring loaded with a compression spring 44. The compression spring 44 pushes against a flange 62 of a first part 60. A protruding end 64 of the first part 60 is shaped to be received within a receptacle 66 of a second part 68 of the locking mechanism 36. The protruding end 64 includes fins 70 that are arranged to be inserted within grooves 72 of the receptacle 66. The fins 70 and the grooves 72 include ramps 74 that are shaped to create a rotary force that turns either the first part 60 or the second part 68 about a central axis 46 of the locking mechanism 36 as the protruding end 64 enters the receptacle 66.

[0079] Either the first part 60 or the second part 68 is attached to the cross bar 18. Thus, as the first part 60 and the second part 68 move linearly with respect to one another along a length of the central axis 46, either the first part 60 or the second part 68 will rotate about the central axis 46. As a result, the cross bar 18 may be rotated by linearly moving the first or second part 60, 68 with respect to one another. In some embodiments, the second part 68 is arranged so that the user may move the second part 68 back and forth to cause the cross bar 18 to rotate each time that the ramps 74 engage. In such examples, the second part 68 may be spring loaded so that the second part 68 returns to its original position after it is pushed in. Thus, the user may push the button multiple times to rotate the cross bar 18 to the desirable orientation.

[0080] FIG. 7 illustrates a cross sectional view of an alternative example of a locking mechanism 36 in accordance with the present disclosure. In this example, a tension spring 76 is located within a bore 78 of the central shaft. The tension spring 76 pulls on the first plate 38 to keep the first plate 38 and the second plate 40 interlocked. By moving the first plate 38 in a release direction, which is away from the second plate 40, the holes 48 in the first plate 38 will be pulled away from the protrusions 56 such that either the first plate 38 or the second plate 40 are free to rotate about the central axis 46. In this example, the cross bar 18 is attached to the first plate 38. The direction that the cable moves in response to the user pulling against the resistance mechanism may be aligned with the spring force or opposing the spring force.

[0081] FIG. 8 illustrates a perspective view of an example of a component of a locking mechanism 36 in accordance with the present disclosure. In this example, the first part 60 and the second part 68 include complementary interlocking surfaces 80. Each of the complementary interlocking surfaces 80 includes crests 82 and roots 84 that are joined with inclined surfaces 86. An advantage of these types of complementary interlocking surfaces 80 is that a hole 48 of the first part, such as the first plate 38, does not have to exactly line up with a hole 48 of the second part, such as the second plate 40, when the second plate 40 is moving in the locking direction. In the example of FIG. 8, the orientation of the cross bar can be such that the crests 82 of the first part may be misaligned with the roots 84 of the second part 68, but as the first part 60 and the second part 68 come together, the inclined surfaces 86 will guide the first part 60 and/or second part 68 into proper alignment.

[0082] While the example of FIG. 8 is depicted with a specific depth between the crests 82 and the roots 84, any appropriate depth may be used. For example, a shallower depth with an increased number of crests 82 and roots 84 may provide more azimuthal orientation options of the cross bar 18. On the other hand, fewer crests 82 and roots 84 with a greater depth may allow for a fewer number of azimuthal orientations that the cross bar may occupy when the first part 60 and the second part 68 are interlocked.

[0083] FIGS. 9a-c illustrates side views of alternative plates of locking mechanisms in accordance with the present disclosure. In the example of FIG. 9a, the holes 48 in the first plate 38 will extend through the entire thickness of the first plate 38. Thus, the holes 48 are formed in both a first face 88 and a second face 90 of the first plate 38. In the example of FIG. 9b, the holes 48 in the first plate 38 extend through just a part of the thickness of the first plate 38. Thus, the holes 48 are formed in just the first face 88 of the first plate 38. In the example of FIG. 9c, the first plate 38 includes both protrusions 56 and holes 48. In such an example, the second plate 40 can include corresponding holes 48 and protrusions 56 so that the first and the second plates 38, 40 can interlock.

[0084] FIGS. 10a-d illustrates side views of alternative examples of plates of locking mechanisms in accordance with the present disclosure. In the example of FIG. 10a, the first plate 38 includes grooves 92 that are formed in the plate's periphery 94. The grooves are spaced so that corresponding protrusions 56 of the second plate 40 will interlock with at least some of the grooves 92 when the first plate 38 and the second plate 40 come together.

[0085] In the example of FIG. 10b, the first plate 38 includes grooves 92 formed in the plate's periphery 94 as well as holes 48 formed near the periphery. In the example of FIG. 10c, the first plate 38 has just three holes 48. In such an example, there are just three azimuthal positions that the second plate 40 can occupy with respect to the first plate 38 while interlocked with the first plate 38. In the example of FIG. 10d, the multiple holes 48 are formed in the first plate 38 such that subsets of the holes 48 form lines that radiate out from a center of the first plate 38. In such an example, a single row of protrusions 56 may be formed in the second plate 40 and spaced to interlock with a single subset of the holes 48 formed in the first plate 38.

[0086] FIG. 11 illustrates a side view of an alternative example of a locking mechanism 36 in accordance with the present disclosure. In this example, the first part 60 has a conical shape 96 and includes recesses 98 formed in a surface 100 of the conical shape 96. The second part 68 includes a receptacle 101 shaped to receive the conical shape 96 of the first part 60. Such a receptacle includes ridges 103 that interlock with the recesses 98. The first part 60 or the second part 68 can be moved in a release direction such that the first part 60 is released from the second part 68 to allow a user to rotate the cross bar 18 that can be attached to either the first part 60 or the second part 68.

[0087] FIG. 12 illustrates a side view of an alternative example of a locking mechanism 36 in accordance with the present disclosure. In this example, the central pivot shaft 42 includes a thread form 102. The central pivot shaft 42 also includes a handle 104 that is accessible to the user. As the user rotates the handle 104, the thread form 102 causes the second part 68 to move along the length of the central pivot shaft 42 in a release direction such that the first part 60 is freed from the second part 68. In such a free state, the second part 68 can be rotated about the central axis 46 of the central pivot shaft 42 such that the cross bar 18 is moved to the desired orientation. Next, the user can rotate the handle 104 in a reverse direction such that the second part 68 is moved in a locking direction so that the first part 60 and the second part 68 will interlock.

[0088] FIG. 13 illustrates a front perspective view of an example of a pull exercise machine 10 in accordance with the present disclosure. In this example, the pull exercise machine 10 includes a first arm 106 and a second arm 108 that move independently of each other. The first arm 106 can rotate about a shaft of a first pivot connection 110, and the second arm 108 can rotate about a shaft of a second pivot connection 112. A first handle 114 is connected to an end of the first arm 106, and a second handle 116 is connected to an end of the second arm 108. A first cable 118 is supported by the first arm 106, and a second cable 120 is supported by the second arm 108. Each of the first cable 118 and the second cable 120 is connected to resistance mechanism.

[0089] The first pivot connection 110 and the second pivot connection 112 can incorporate the first part 60 and the second part 68 as described above such that either the first arm 106 and/or the second arm 108 are connected to either the first part 60 or the second part 68. The first arm 106 and/or second arm 108 can be released by pushing the arm in a release direction. In such a released state, the first arm 106 and/or second arm 108 can be oriented to the desired azimuthal position. When the desired azimuthal position is reached, the first arm 106 and/or second arm 108 can be moved in a locking direction to cause the first part 60 and the second part 68 to interlock, and thereby lock the first arm 106 and/or second arm 108 in the desired azimuthal position.

[0090] FIG. 14 illustrates a front perspective view of an example of an exercise machine 122 in accordance with the present disclosure. In this example, the exercise machine 122 includes a bench 124 with an adjustable back support 126. Further, the exercise machine 122 includes a press bar 128 for pushing a load that is supported by a vertical column 130.

[0091] The principles described in the present disclosure may be incorporated into any appropriate joint of any appropriate exercise machine. In the example of FIG. 14, the principles described in the present disclosure may be incorporated into the press bar 128 such that the angle of the press bar 128 relative to the vertical column 130 can be changed. Such angular changes in the press bar 128 may be useful for accommodating different sizes of users as well as targeting specific muscle groups.

[0092] Further, the principles described in the present disclosure may be incorporated in an adjustable joint 30 between the seat of the bench 124 and the back support 126. In such an example, the user may pull a handle, rotate a handle, press a button, use another type of mechanism, or combinations thereof to activate a release of the first part 60 from the second part 68 by moving the first part 60 or the second part 68 along a central axis. Once freed, the back support, which is rigidly connected to either the first part 60 or the second part 68, can be pivoted to a desired orientation. When the desired orientation is reached, the user may use any appropriate mechanism to cause either the first part 60 or the second part 68 to move in a locking direction so that the first part 60 and the second part 68 will interlock thereby locking the back support 126 in the desired orientation.

INDUSTRIAL APPLICABILITY

[0093] In general, the invention disclosed herein may provide a user with the advantage of an easy and convenient mechanism for changing the angle of the components of the exercise machines. For example, the user may position the angle of a cross bar, an arm, a back support, a press bar, a cable support, a resistance mechanism, a leg press mechanism, another component, or combinations thereof to meet the user's preferences. The adjustment of such components may be beneficial to appropriately position the components of the exercise machine for the user's size and to assist the user in targeting specific muscle groups.

[0094] In some embodiments, the user can push or otherwise move the component to release the components from an interlocked state within another part of the exercise machine. In the freed state, the user can change the orientation of the component. When the user desires to fix the component in a particular position, the user may pull or otherwise move the component such at that the component interlocks with a part of the exercise machine.

[0095] Not all users have the same ability for changing the angle of the components of the exercise machine. For example, elderly users or users with less agility may prefer release and interlock mechanisms that able users may find tedious. Any appropriate mechanism may be used to cause the component to interlock or be released from the part. Buttons may be a convenient mechanism for some users. A push motion to release and a pull motion to interlock may be desirable for other users. In some examples, the movement of the first part 60 or the second 68 can be accomplished with motors, linear actuators, electronically controlled mechanisms, other types of mechanisms, or combinations thereof. In such examples, a user may cause the first part 60 or the second part 68 to move in either the release direction or the locking direction with controls in a control module of the machine.

[0096] Further, the first part or the second part may be spring loaded to keep the components of the adjustable joint in a locked position. For example, an entire plate with multiple protrusions may be spring loaded such each of the protrusions of the plate move together as the plate moves. In other examples, the part with the holes, recesses, or grooves moves.

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WHAT IS CLAIMED IS:

1. An exercise machine, comprising:

an adjustable joint comprising a first part and a second part that are shaped to rotate relative to each other such that when an orientation between the first part and the second part changes a position of a user contact feature also changes;

a locking mechanism positioned to lock the first part and the second part together;

wherein the locking mechanism is positioned to interlock the first part and the second part in a locking direction and to release the first part from the second part in a release direction; and

wherein when the first part and the second part are interlocked at least two first part features are interlocked with at least two second part features simultaneously.

2. The exercise machine of claim 1, wherein the first part and the second part are connected with a central pivot shaft shaped to allow the first part and the second part to rotate about a central axis with respect to each other.

3. The exercise machine of claim 2, wherein the locking mechanism is incorporated into the central pivot shaft.

4. The exercise machine of claim 1, wherein the locking mechanism comprises a spring that forms a spring force in the locking direction.

5. The exercise machine of claim 1, wherein the at least two first part features are protrusions and the at least two second part features are receptacles that are spaced receive the protrusions.

6. The exercise machine of claim 5, wherein the receptacles are formed in a periphery of the second part.

7. The exercise machine of claim 5, wherein the receptacles are formed in a face of the

second part.

8. The exercise machine of claim 5, wherein the receptacles are formed in a substantially circular arrangement.

9. The exercise machine of claim 1, wherein the first part and the second part are plates that face one another.

10. The exercise machine of claim 1, wherein locking mechanism incorporates a cam assembly.

11. The exercise machine of claim 1, wherein the at least two second part features are grooves that are formed along a width of the second part.

12. The exercise machine of claim 1, wherein the locking mechanism is arranged to release the first part in response to a pushing action by a user.

13. The exercise machine of claim 1, wherein the adjustable joint is formed in a mechanical linkage that connects a resistance mechanism to the user contact feature.

14. The exercise machine of claim 13, wherein the mechanical linkage between the resistance mechanism and the user contact feature are connected with a cable that is routed through the adjustable joint.

15. The exercise machine of claim 13, wherein the locking direction is aligned with a pull force generated when a user pulls against the resistance mechanism.

16. A pull exercise machine, comprising:

a mechanical linkage that connects a resistance mechanism to handles;

the mechanical linkage comprising an adjustable joint;

wherein the adjustable joint comprising a first plate and a second plate that are connected with a central pivot shaft shaped to allow the first plate and the second plate to rotate with respect to each other such that when an orientation between the first plate and the second plate changes a position of the handles also changes;

a locking mechanism positioned to move at least one of the first plate and the second plate; and

the locking mechanism being positioned to interlock the first plate and the second plate in a locking direction and to release the first plate from the second plate in a release direction;

wherein when the first plate and the second plate are interlocked at least two protrusions of the first plate are inserted into at least two receptacles of the second plate simultaneously.

17. The pull exercise machine of claim 16, wherein the mechanical linkage between the resistance mechanism and the handles are connected with a cable that is routed through the adjustable joint.

18. The pull exercise machine of claim 16, wherein the locking mechanism comprises a spring that forms a spring force in the locking direction.

19. The pull exercise machine of claim 16, wherein the locking mechanism is arranged to release the first plate in response to a pushing action by a user.

20. A pull exercise machine, comprising:

a mechanical linkage that connects a resistance mechanism to at least one handle;

the mechanical linkage including a cable that is routed through an adjustable joint;

the adjustable joint comprising a first plate and a second plate that are connected with a central pivot shaft shaped to allow the first plate and the second plate to rotate with respect to each other such that when an orientation between the first plate and the second plate changes, a position of the at least one handle also changes;

a locking mechanism that is arranged to move at least one of the first plate and the second plate;

wherein the locking mechanism is positioned to interlock the first plate and the second plate in a locking direction and to release the first plate from the second plate in a release direction; and

the locking mechanism comprising a spring that forms a spring force in the locking direction;

wherein when the first plate and the second plate are interlocked at least two protrusions of the first plate are inserted into at least two receptacles of the second plate simultaneously.

ABSTRACT

An exercise machine including an adjustable joint with a first part and a second part that are shaped to rotate with respect to each other such that when an orientation between the first part and the second part changes, a position of the user contact feature also changes. The machine also includes a locking mechanism that is positioned to lock the first part and the second part together. The locking mechanism being positioned to interlock the first part and the second part in a locking direction and to release the first part from the second part in a release direction. When the first part and the second part are interlocked, at least two first part features are interlocked with at least two second part features simultaneously.