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(54) **PIVOTING/TILTING MULTIFUNCTIONAL COLLAPSIBLE FITNESS SYSTEM AND ASSOCIATED SOFTWARE**

(71) Applicant: **GYMENI FITNESS, LLC**, FORT WORTH, TX (US)

(72) Inventor: **Evans A. Carr**, Fort Worth, TX (US)

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(52) **U.S. Cl.**

CPC *A63B 21/0615* (2013.01); *A63B 21/28* (2013.01); *A63B 2071/0625* (2013.01)

(57) **ABSTRACT**

A multifunctional fitness system may allow for high-resistance exercises through the distribution of weight upon a frame pivoting on the ground. In particular implementations, while a user lifts one end of the frame, the opposite end pivots. The weight of another person (and/or that of conventional weighted plates) can be placed on the frame in locations yielding the desired leverage and, thus, resistance felt by the lifter. The frame may have various axes upon which it can pivot and grip points, thus offering a broad range of exercises that can be conducted. Reorienting the frame to be resting on differing sides results in additional feasible exercises. Optional integrated electronics (typically in conjunction with existing smart devices) may use kinematics and/or structural flexing to calculate felt resistance and provide automated instruction to the various users. The may also collapse into a compact, rollable configuration for easy transport.

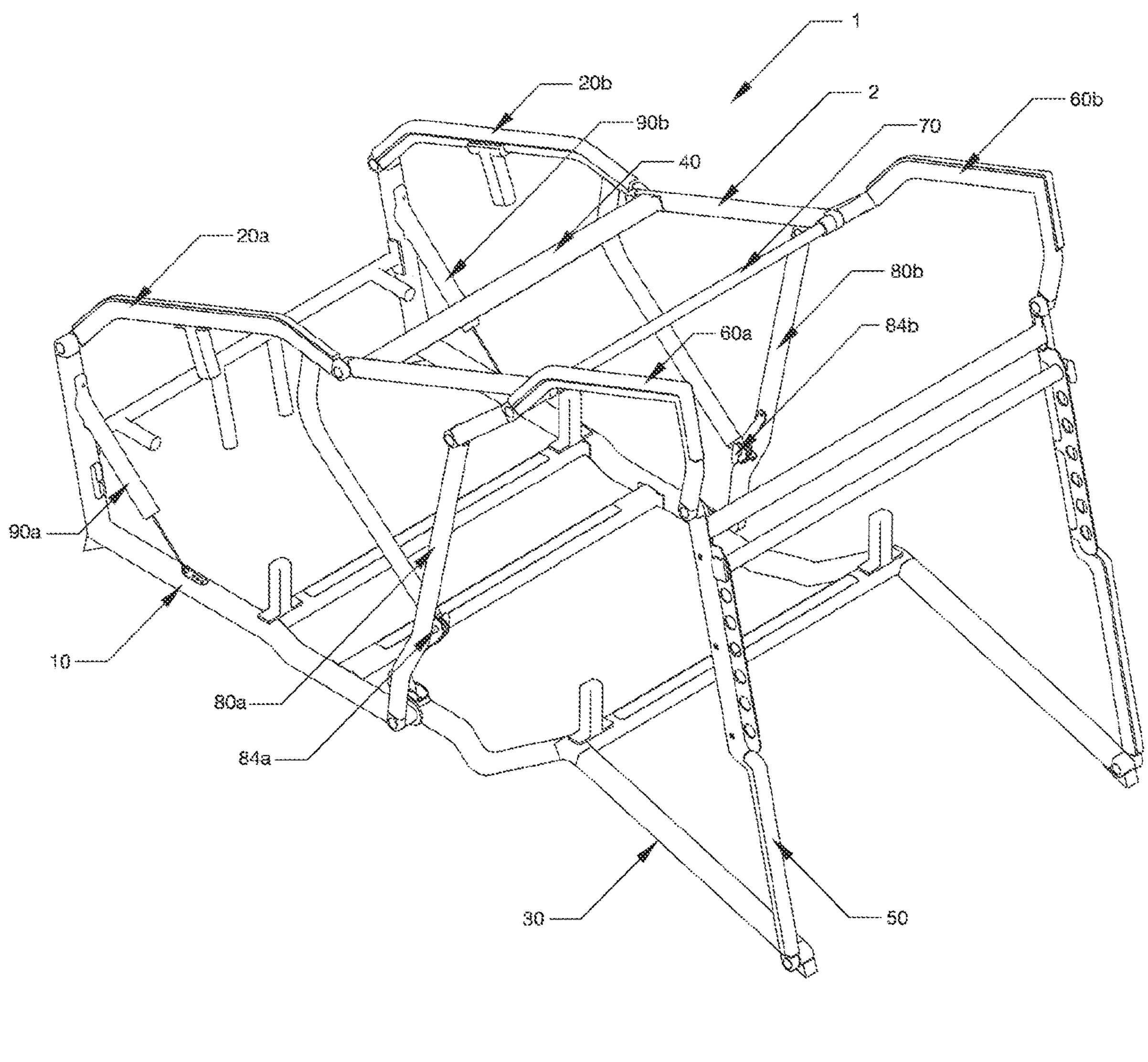


FIGURE 1:

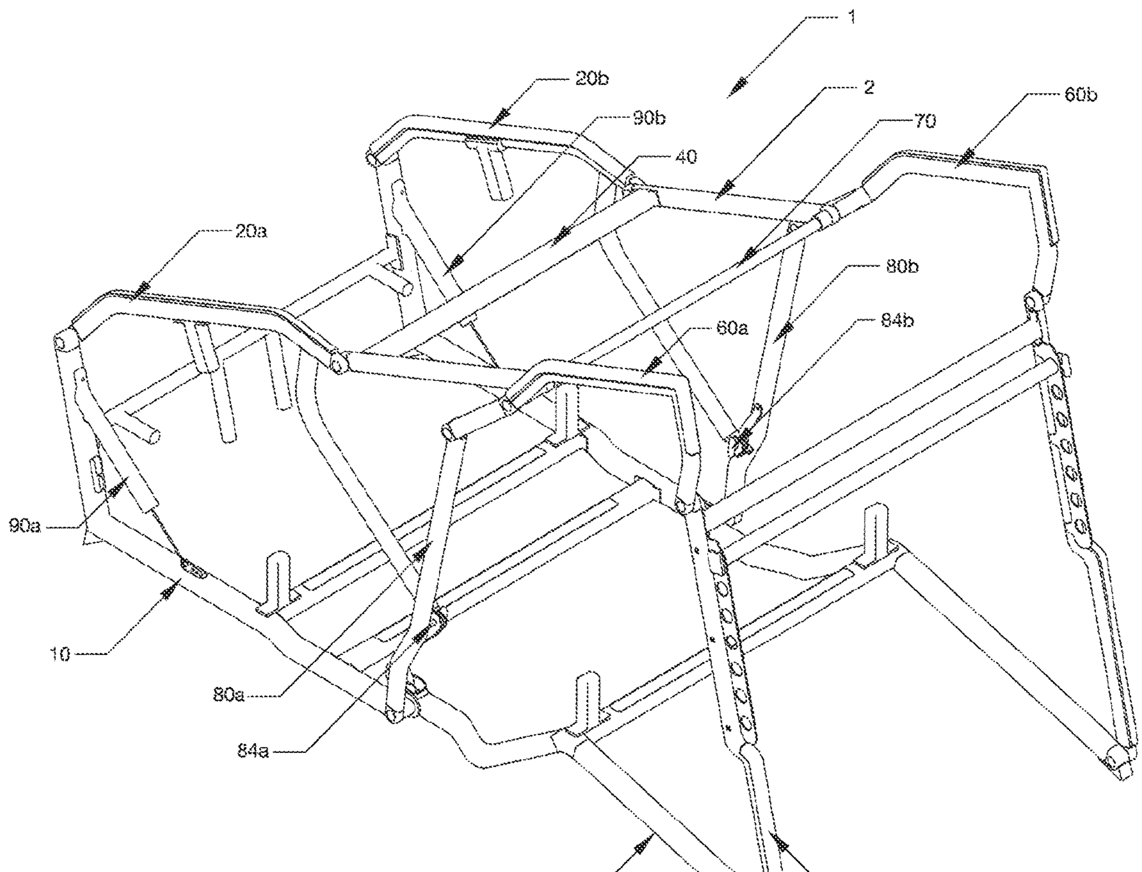
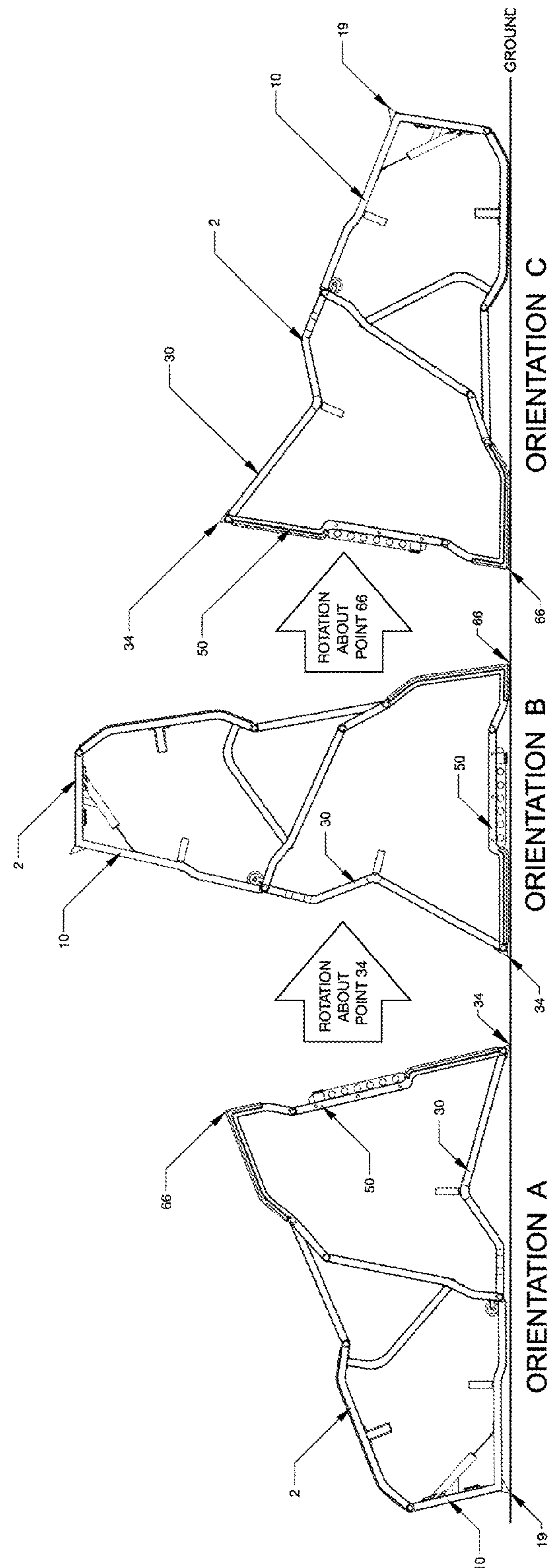
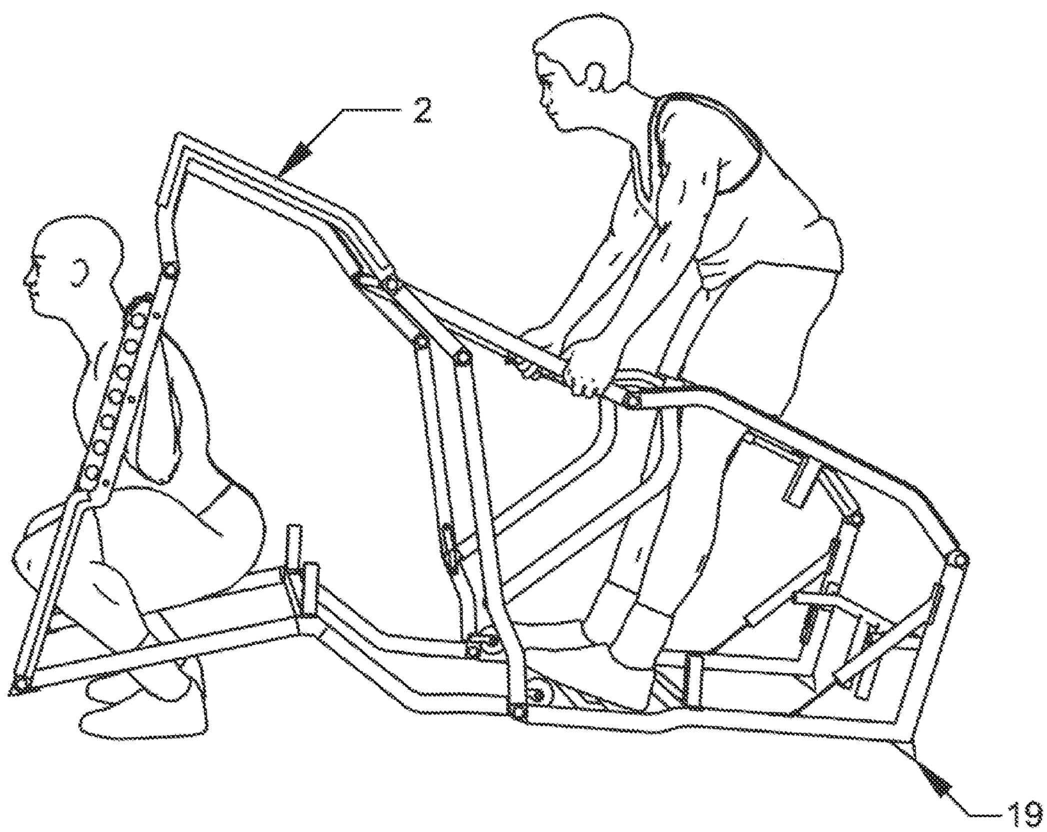


FIGURE 2:



ORIENTATION A
ORIENTATION B
ORIENTATION C
ROTATION ABOUT POINT 34
ROTATION ABOUT POINT 66
GROUND
2
10
19
30
34
50
66

FIGURE 3:



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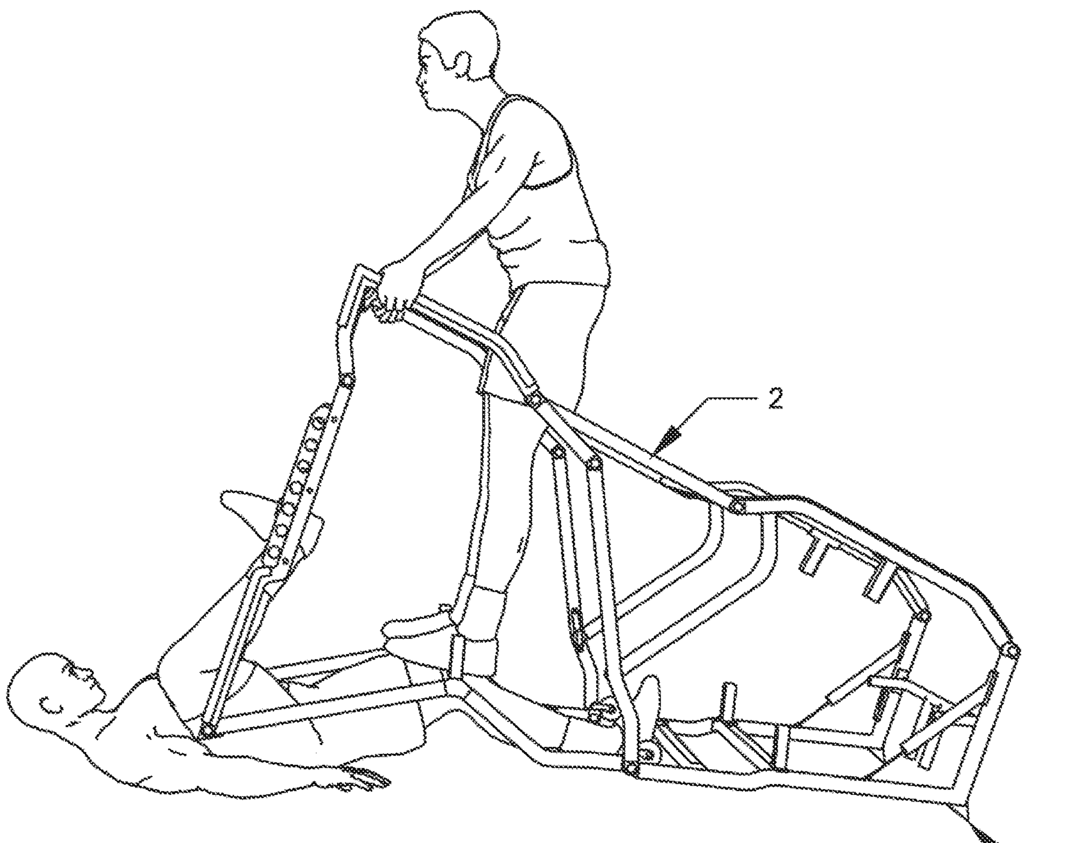

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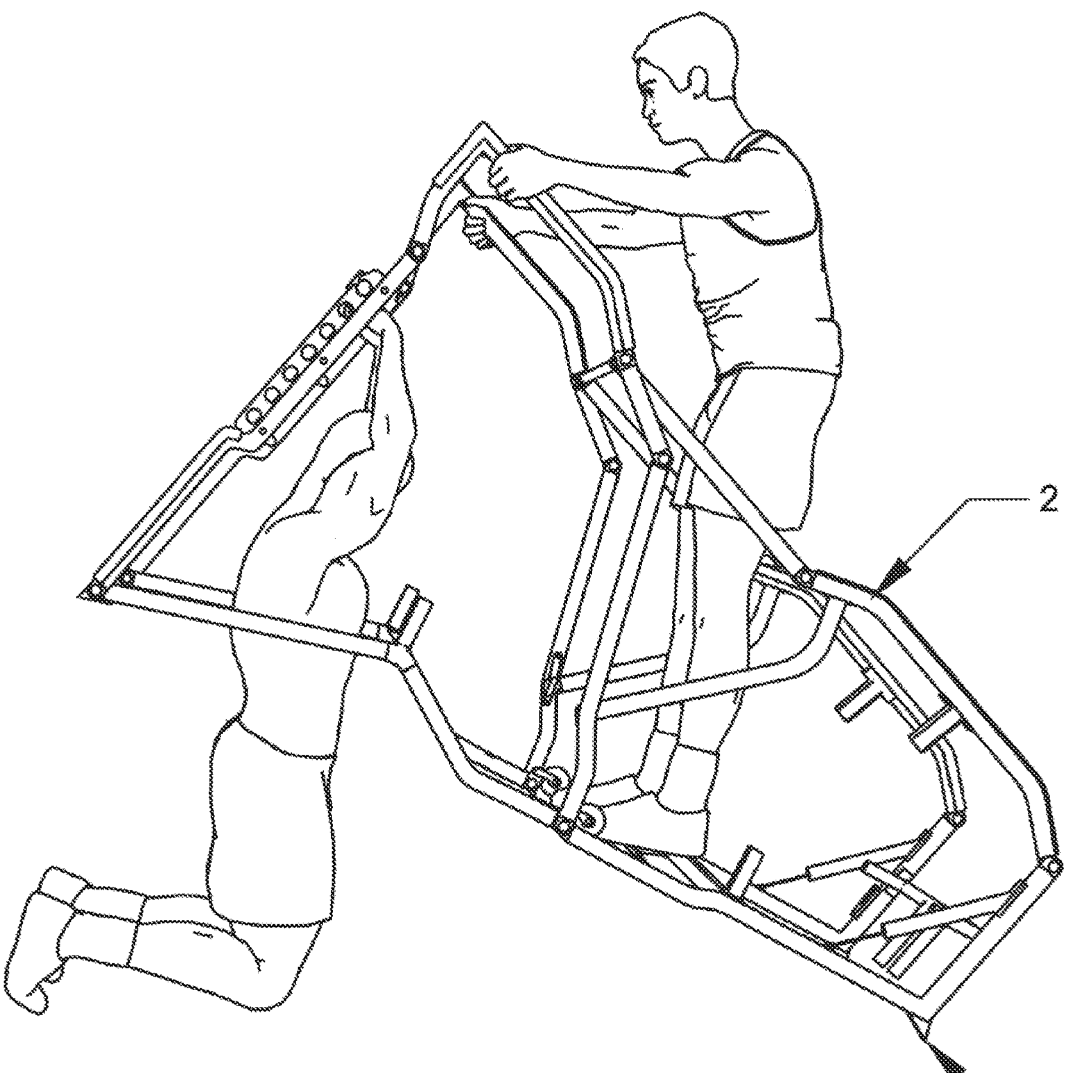

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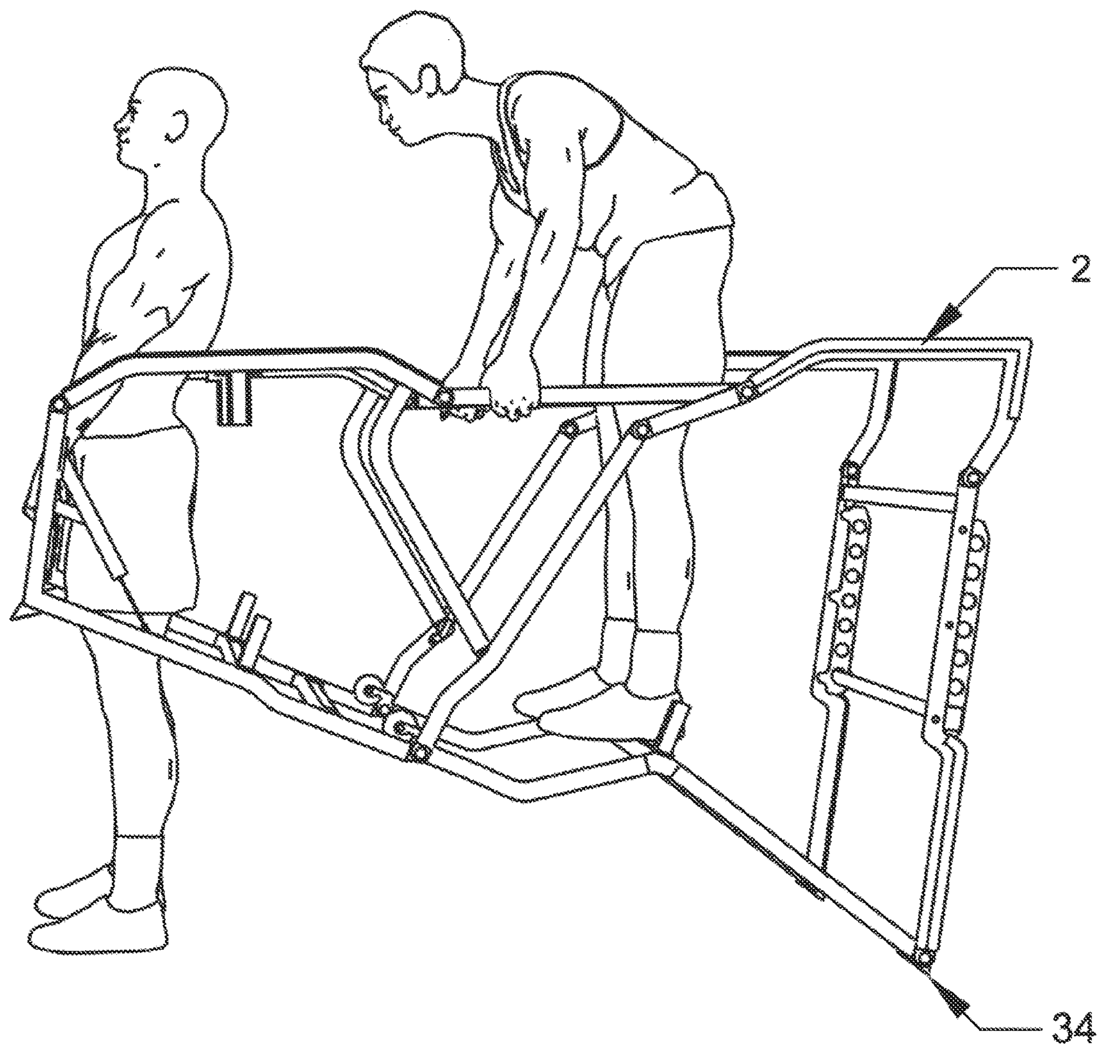

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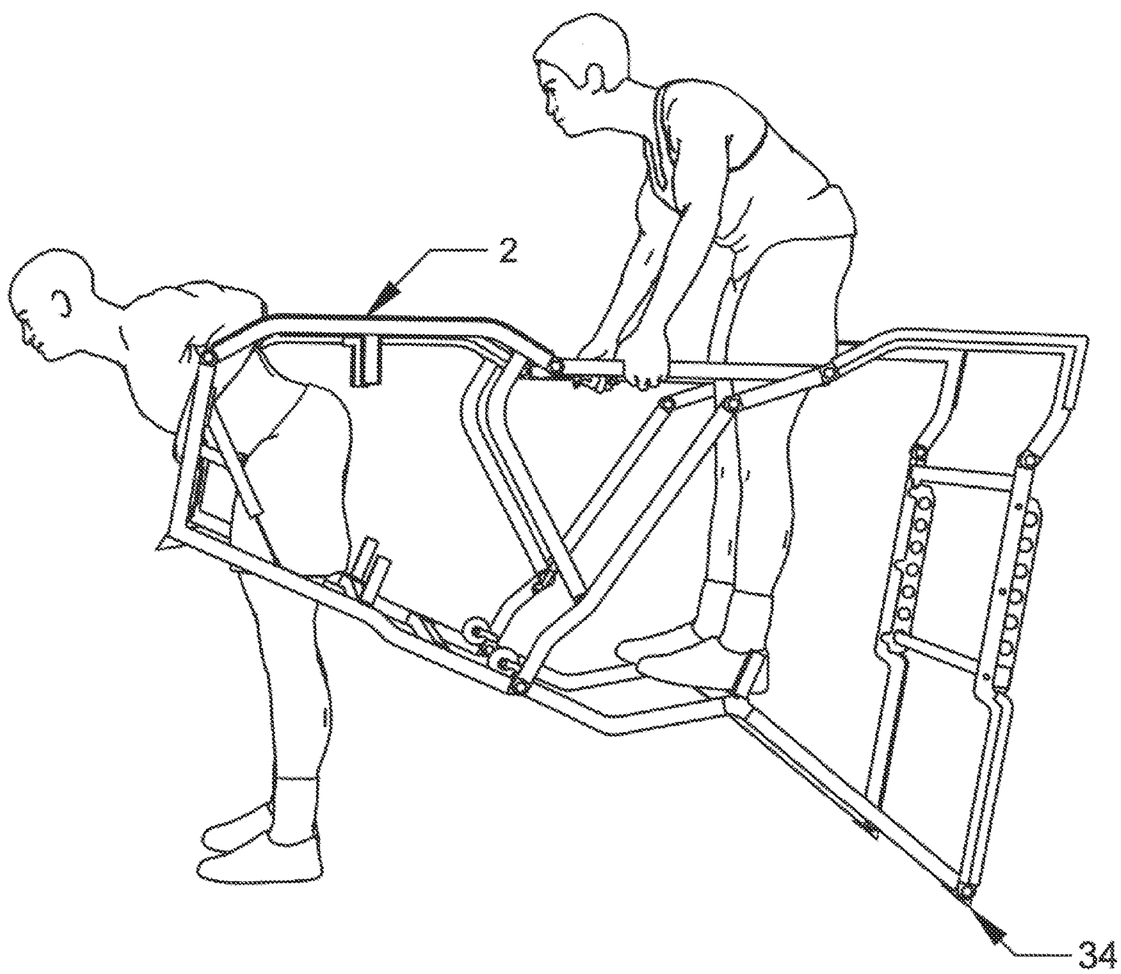

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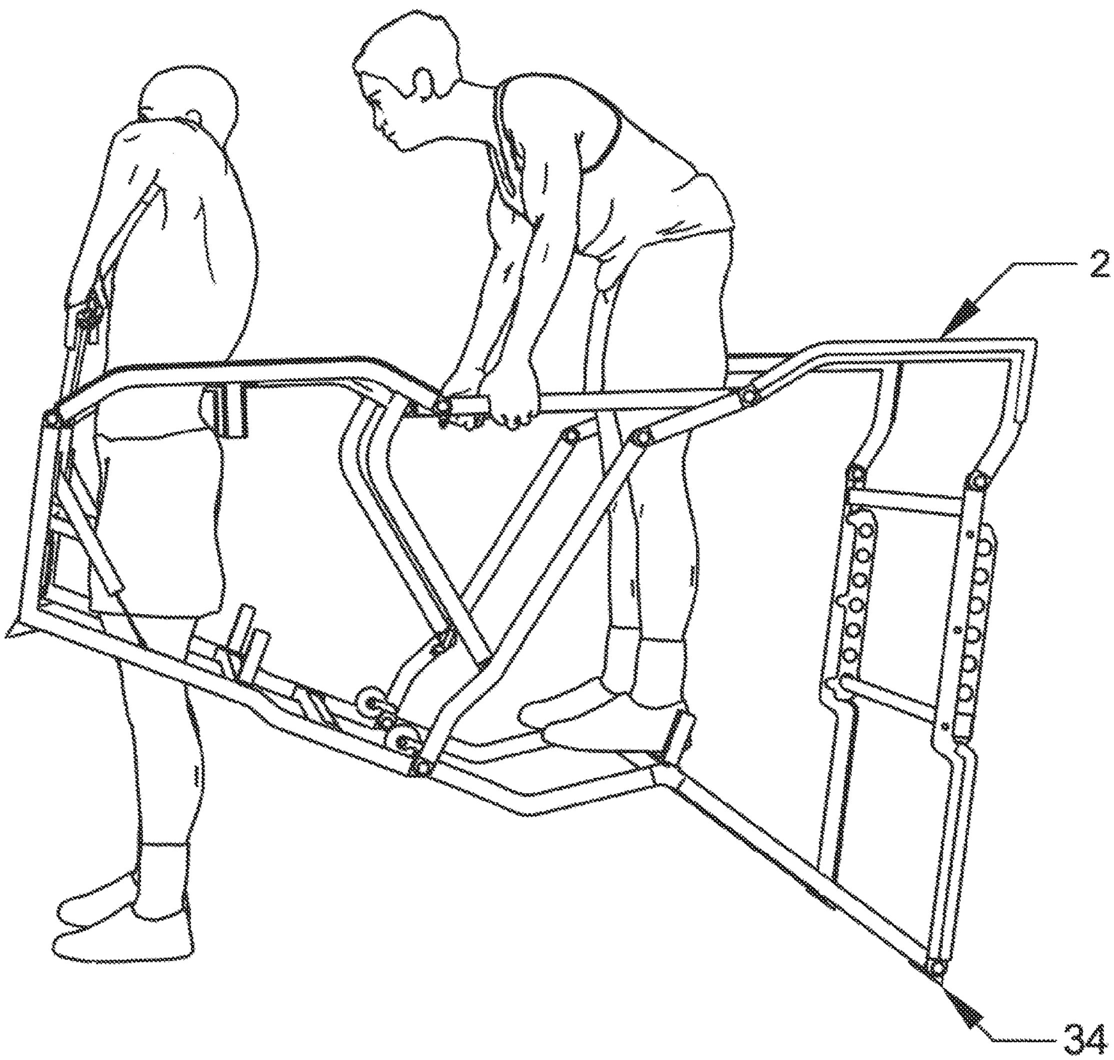

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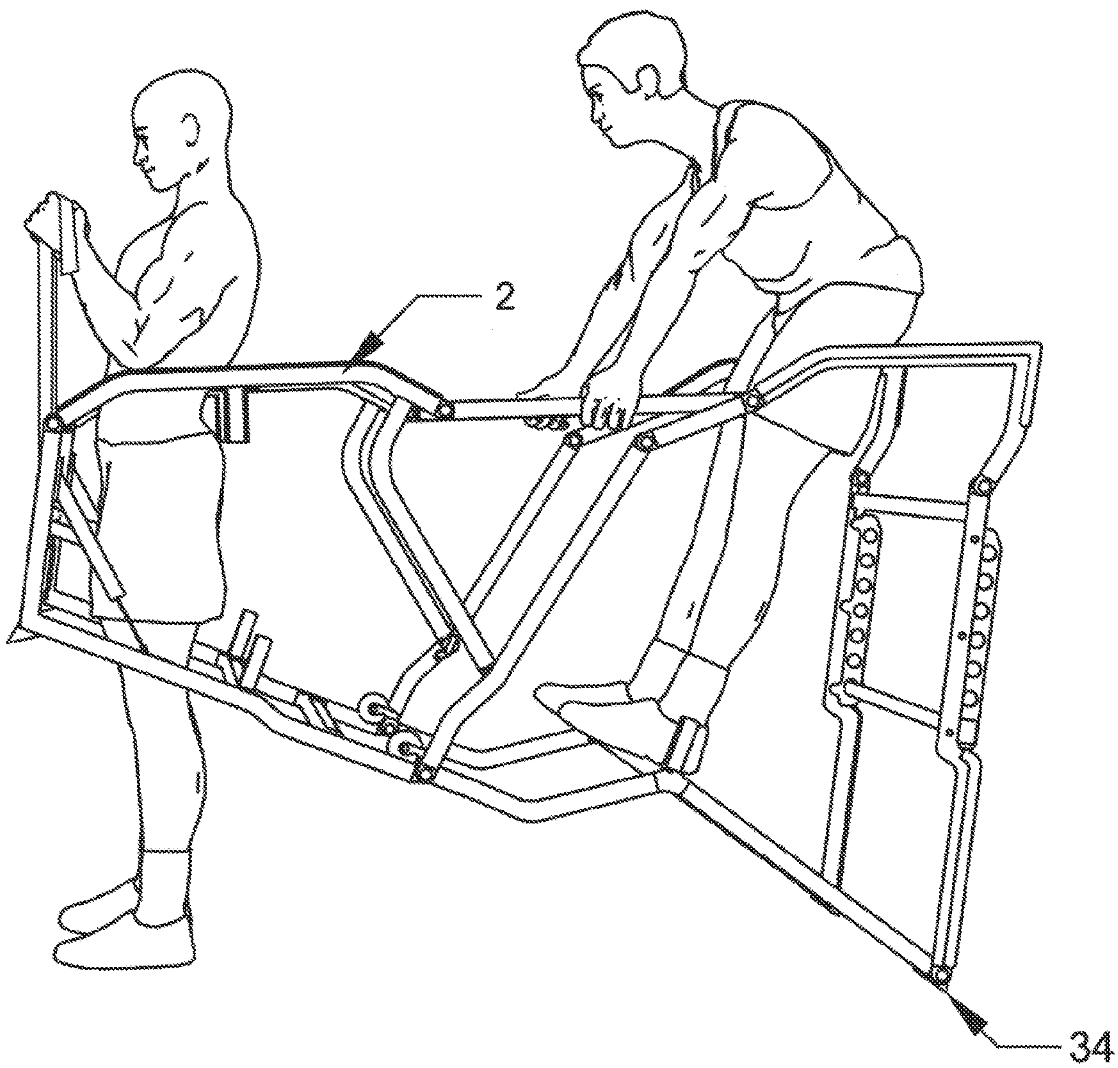

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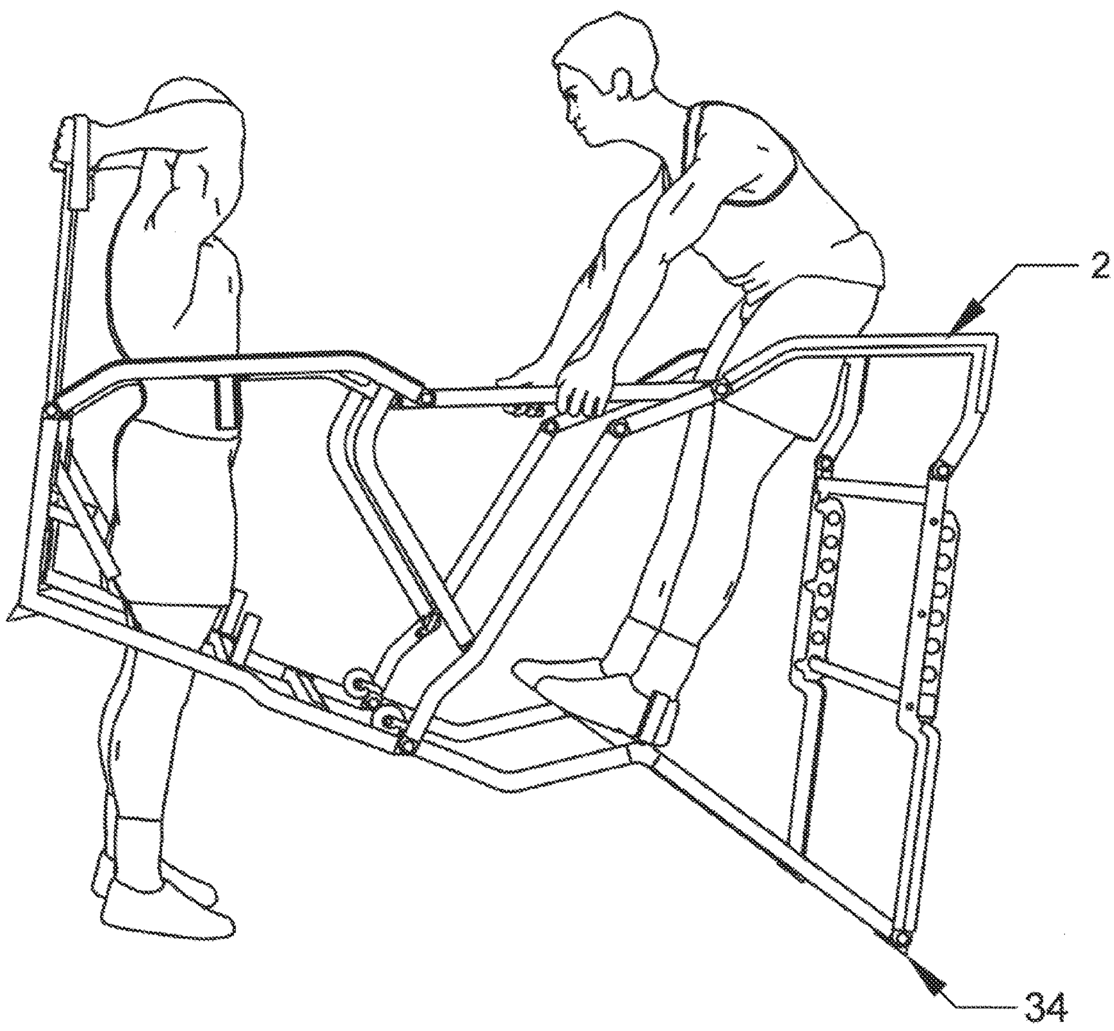

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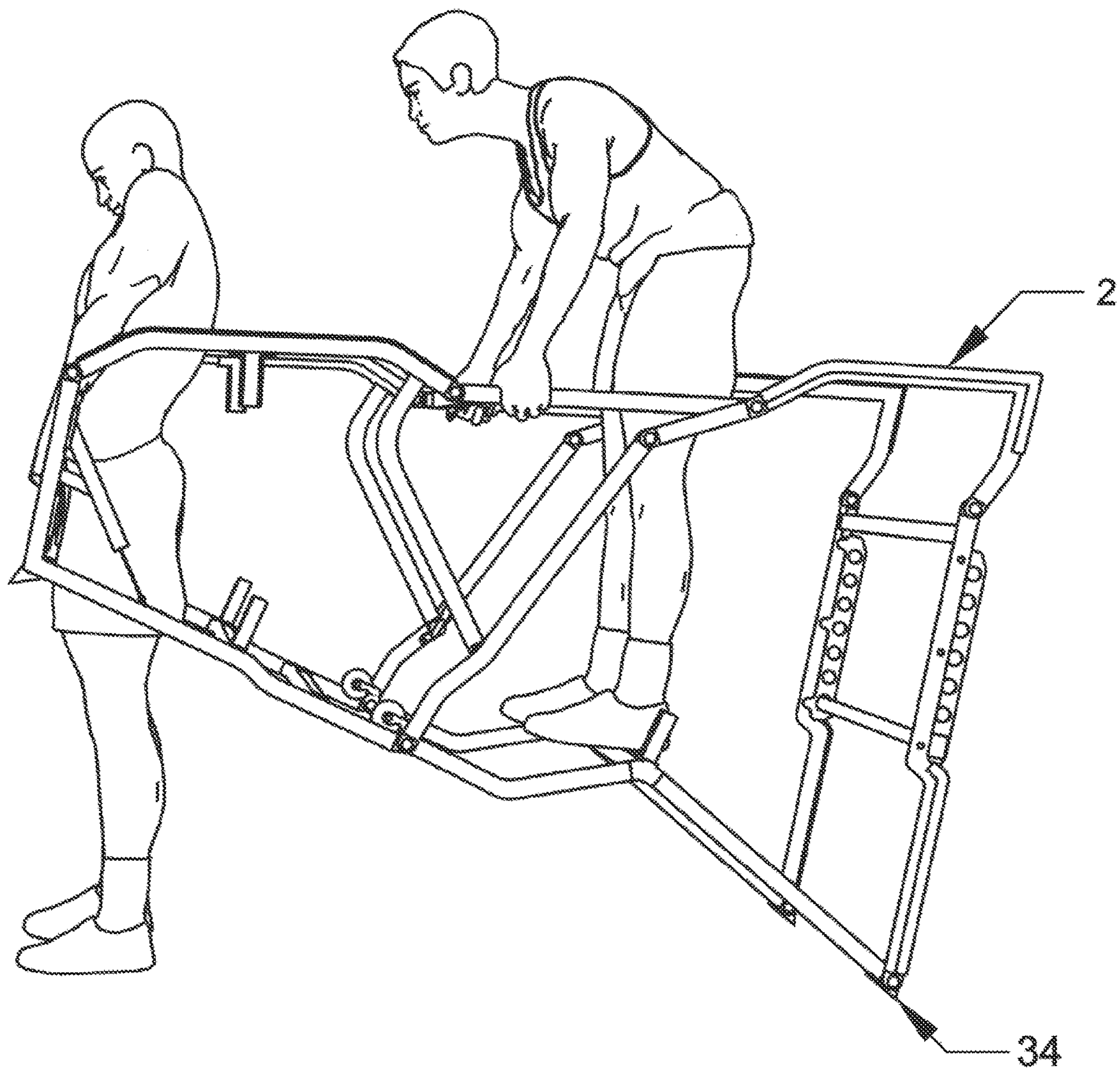

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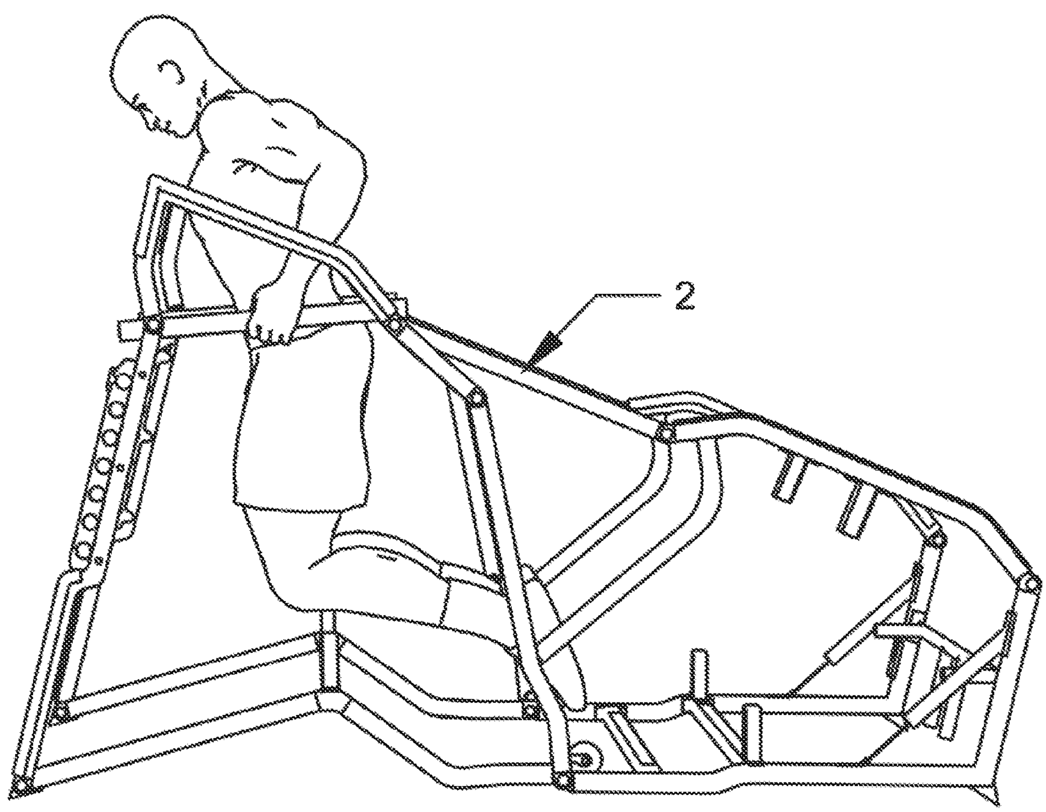

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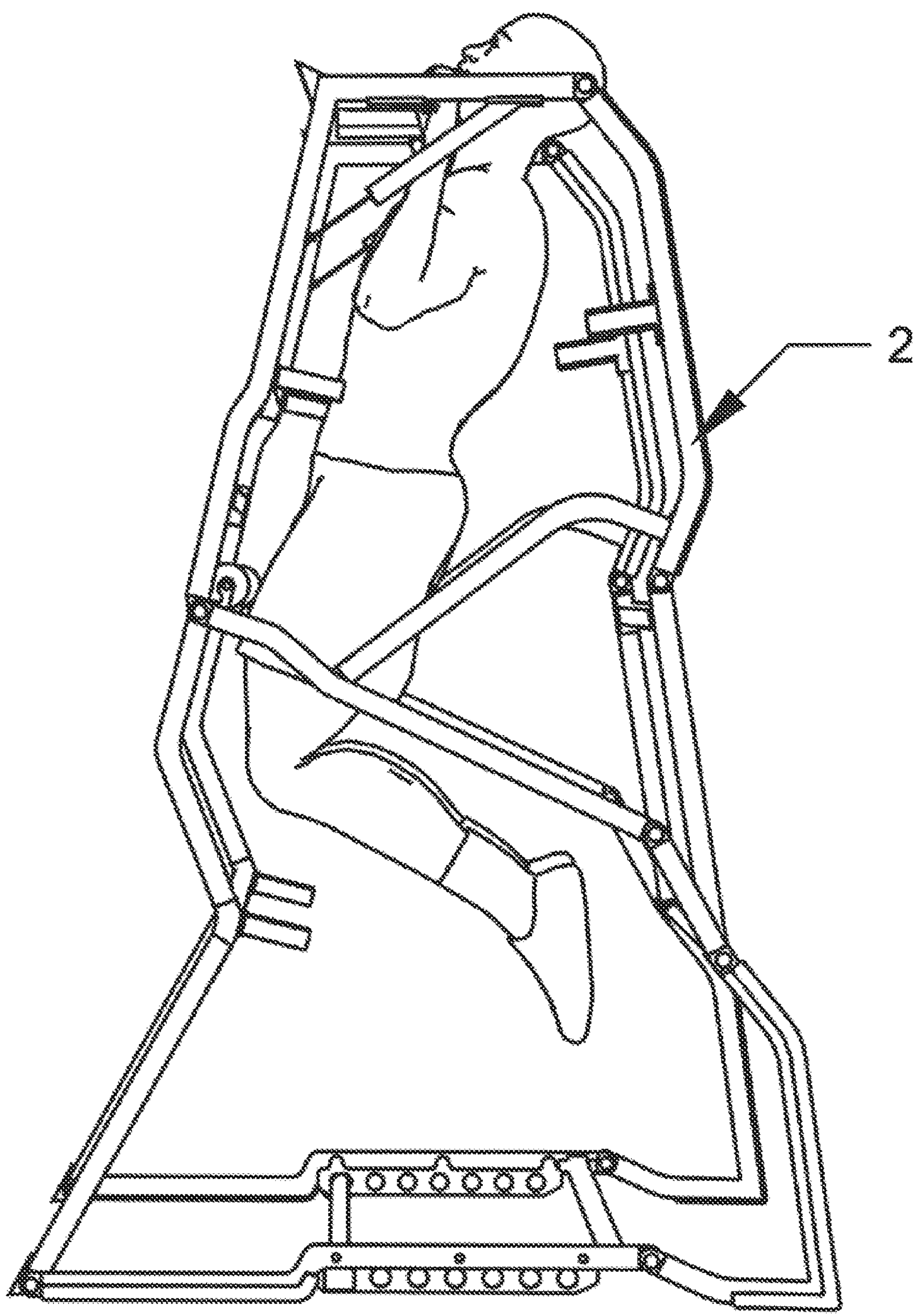

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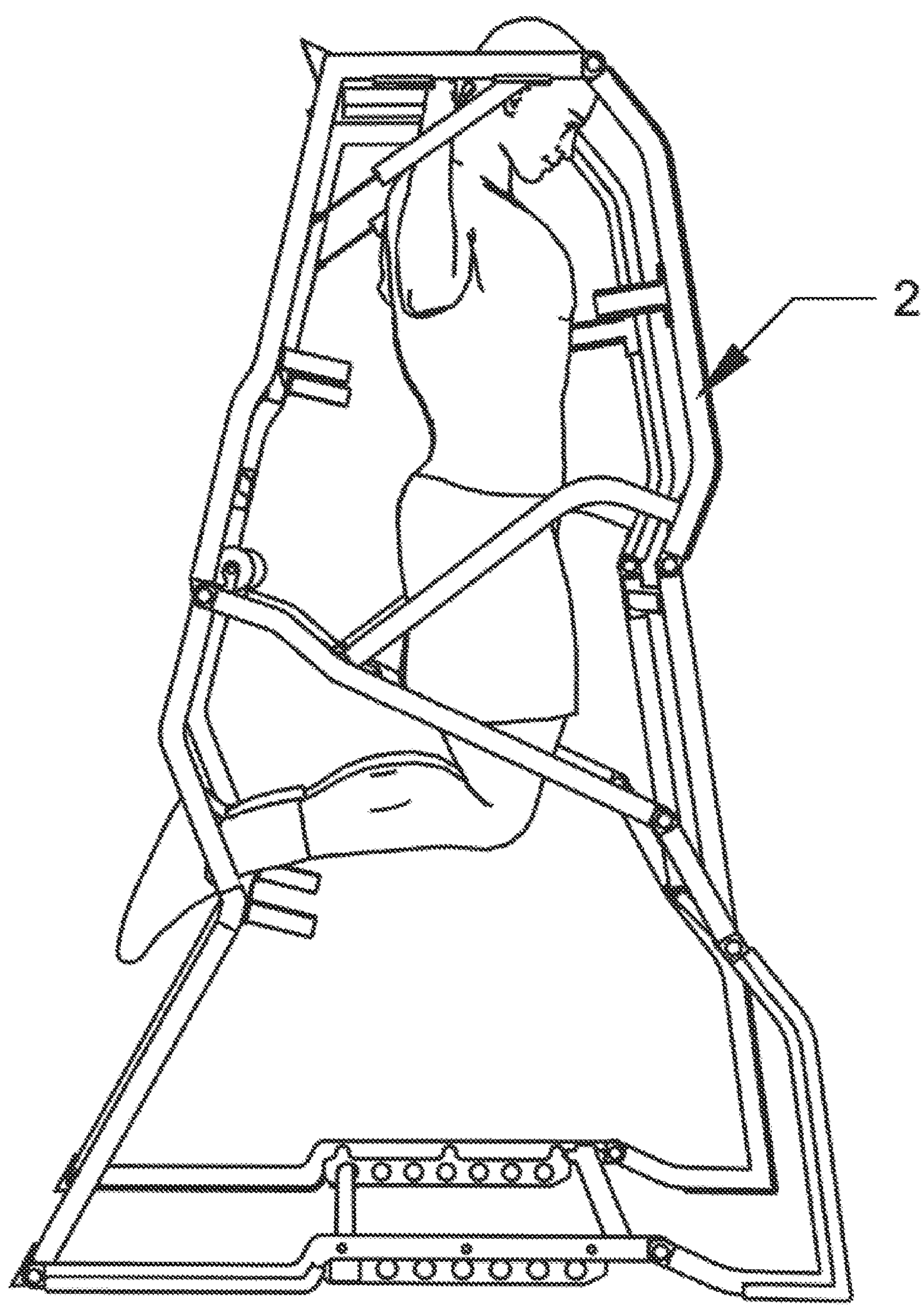

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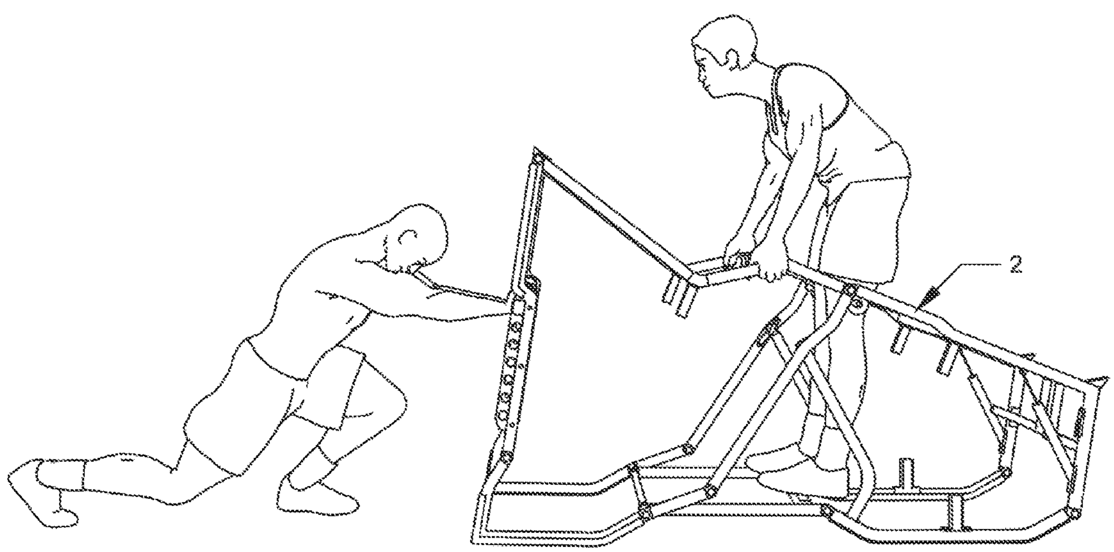

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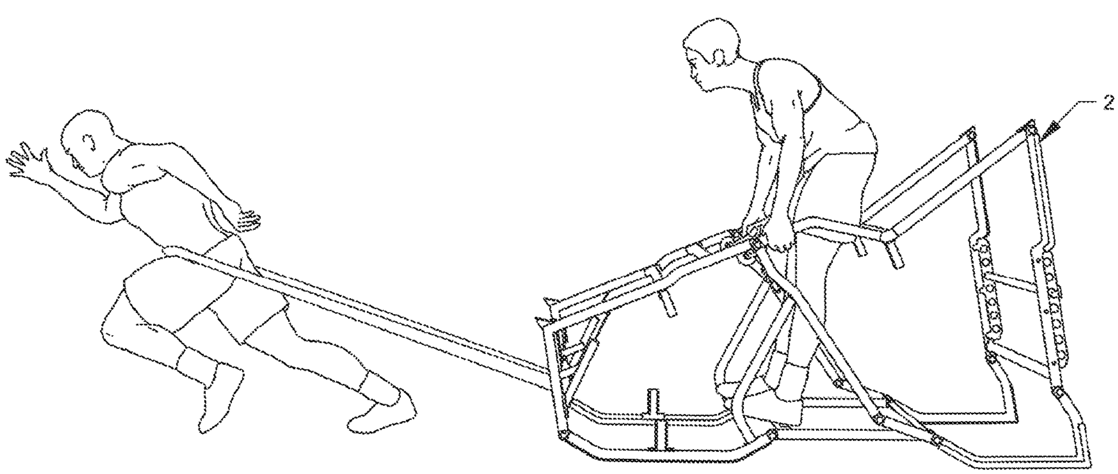

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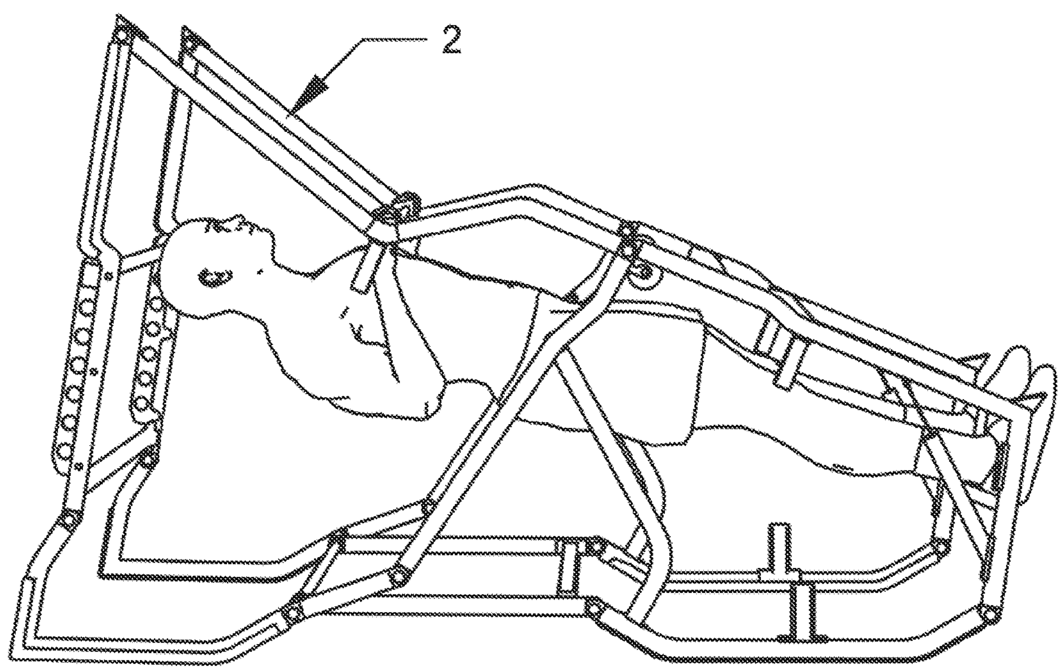

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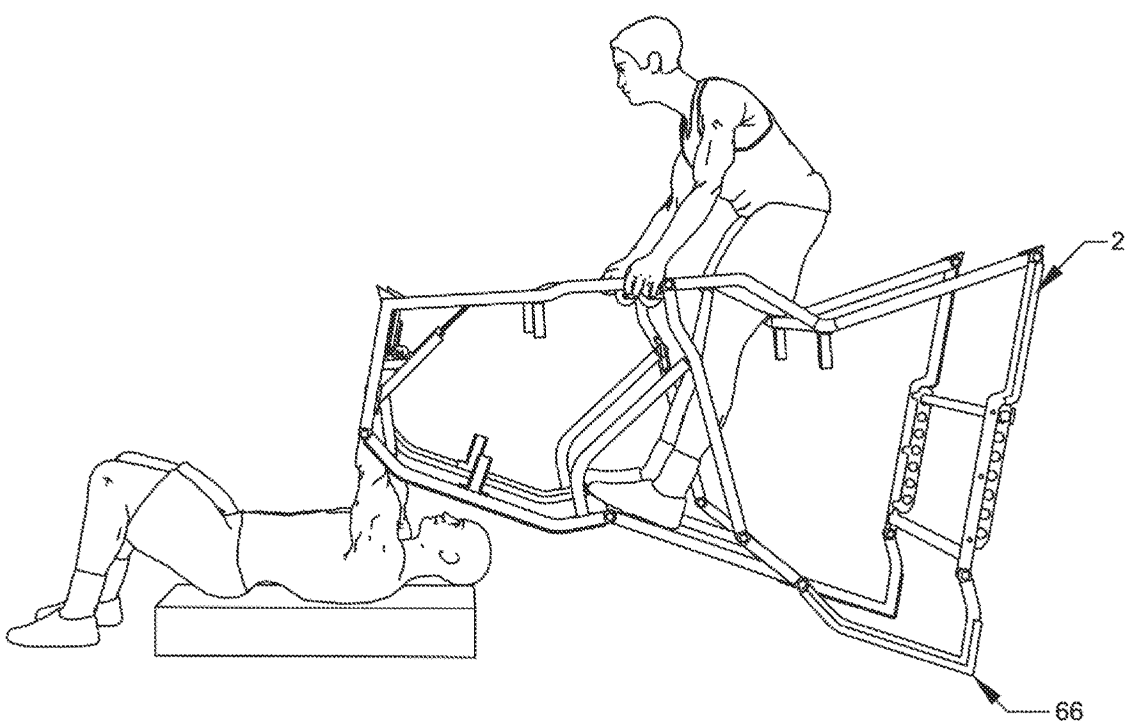

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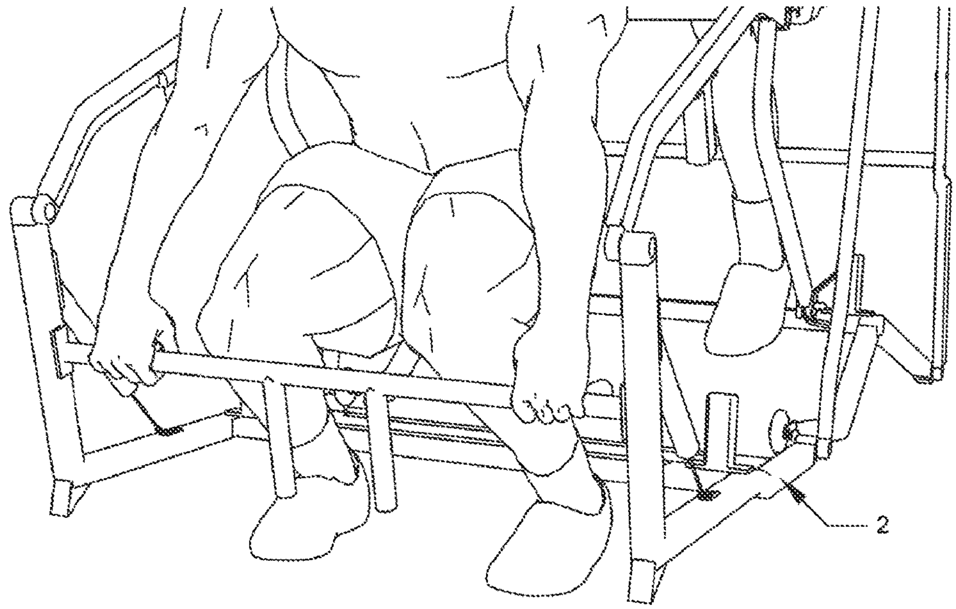
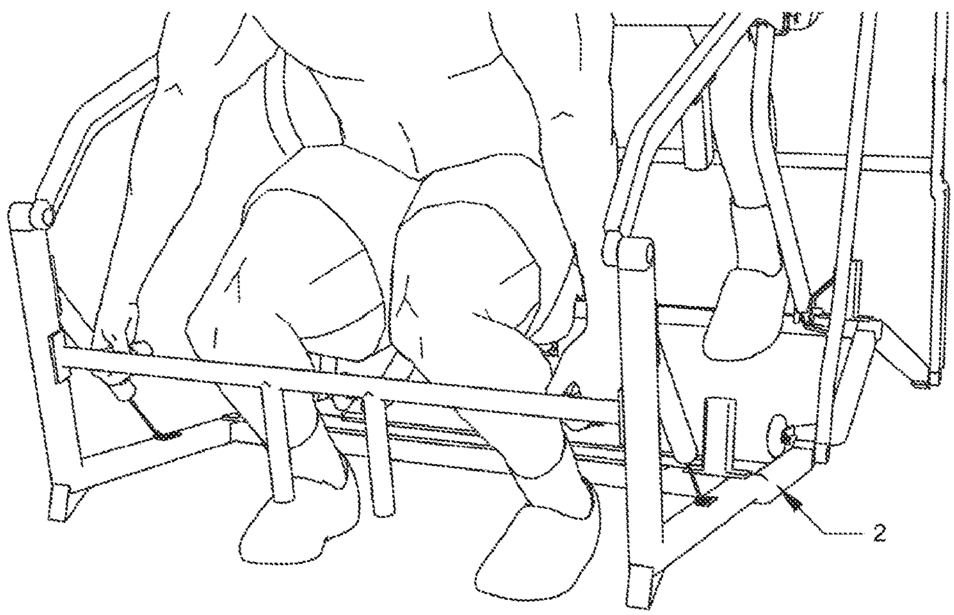
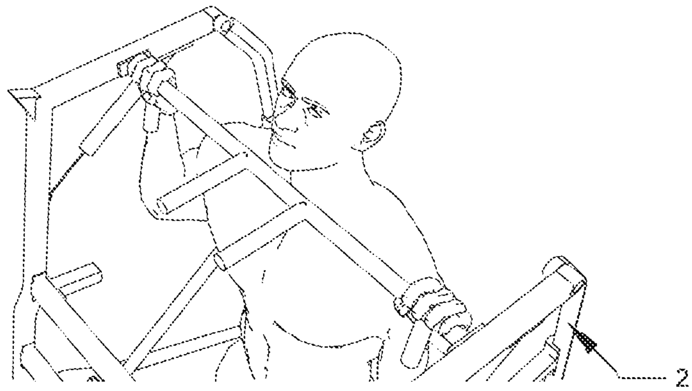


STRAIGHT GRIP

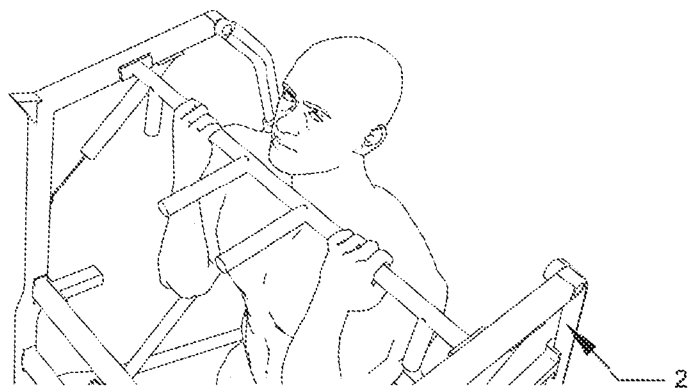


PARALLEL GRIP

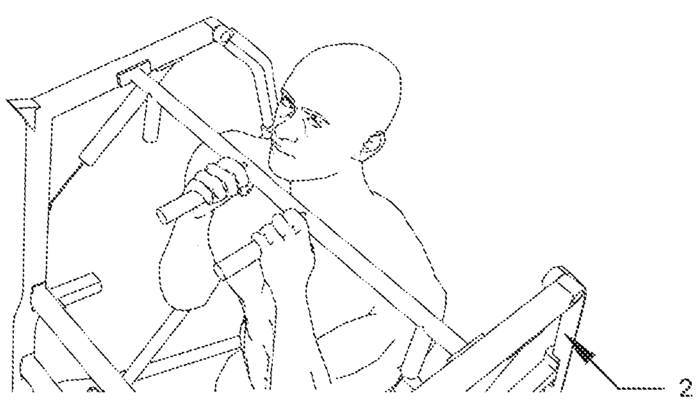
FIGURE 20:



STRAIGHT GRIP

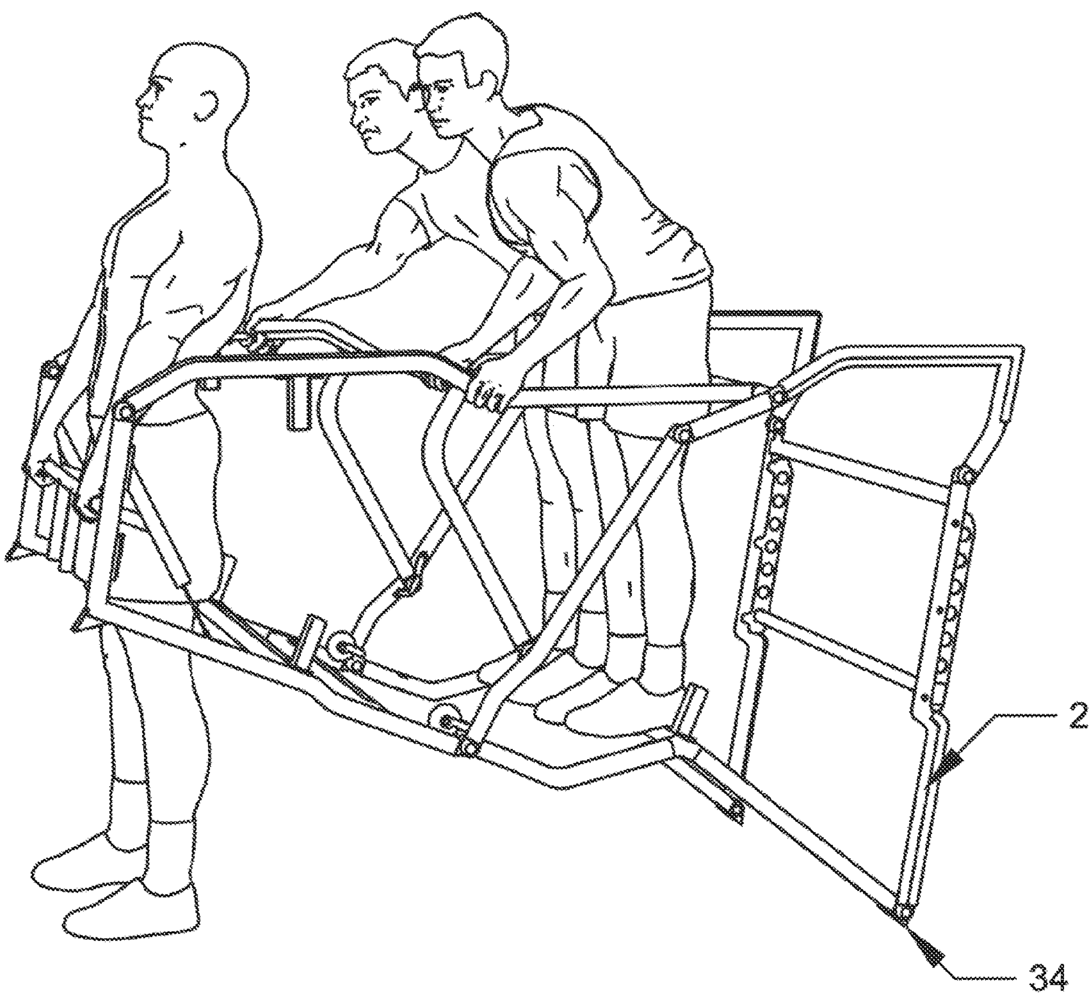


REVERSE GRIP



PARALLEL GRIP

FIGURE 21:



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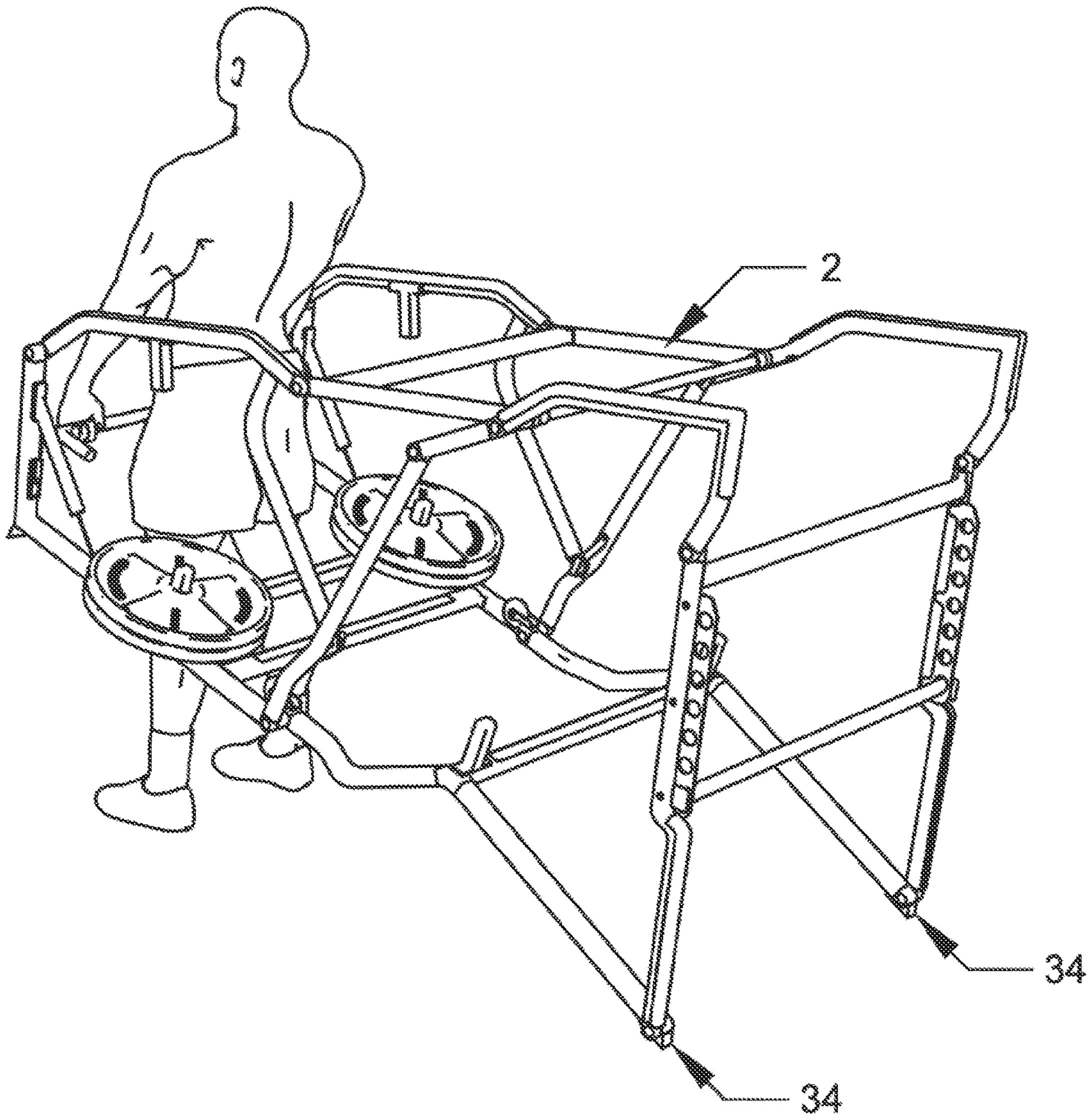

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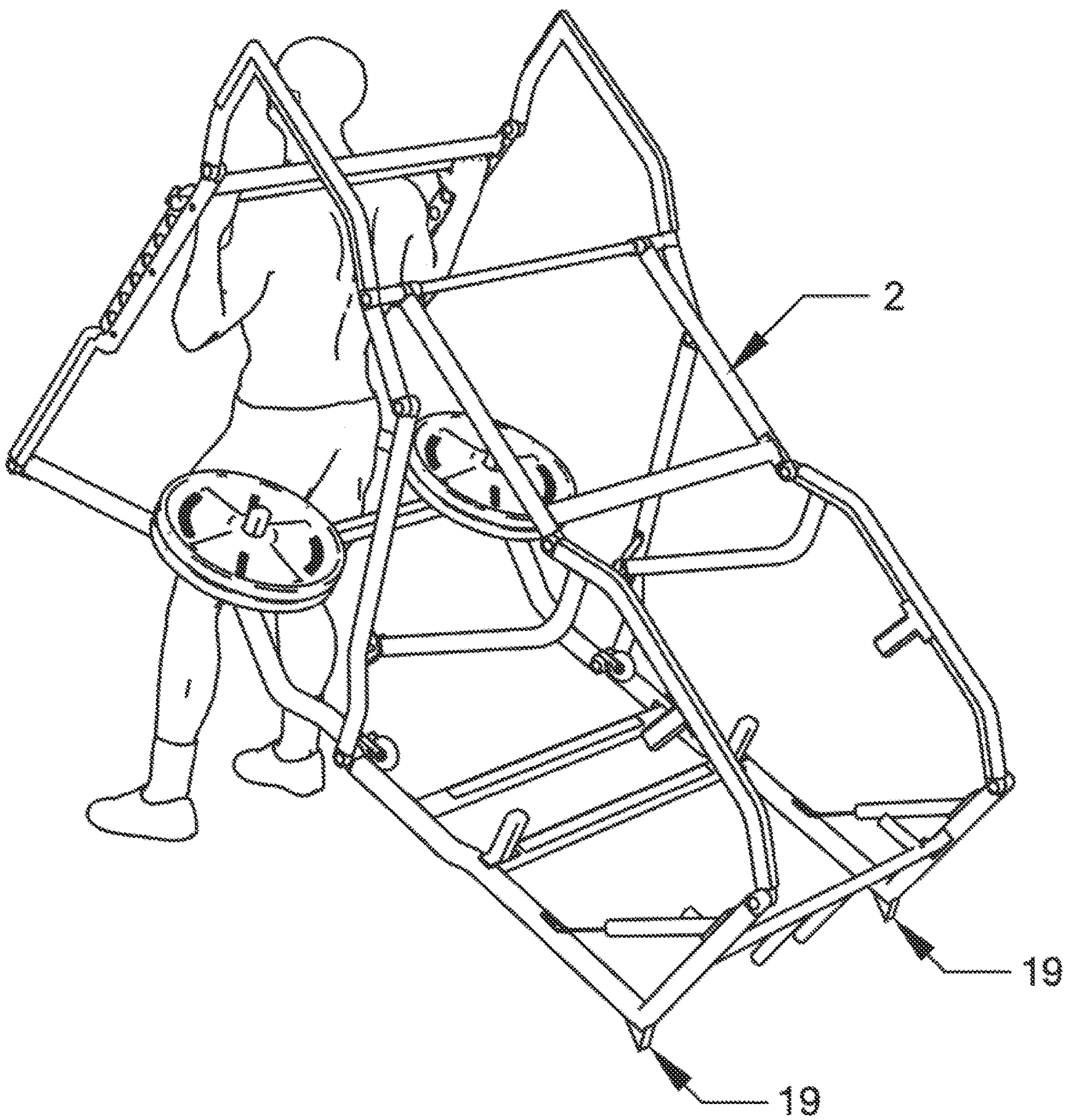

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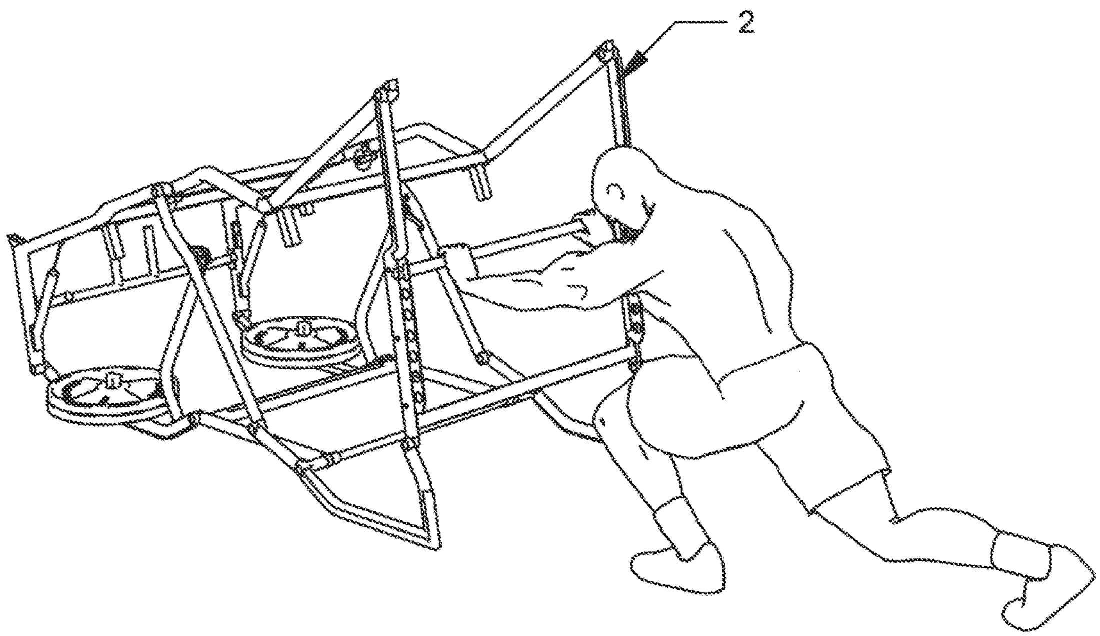

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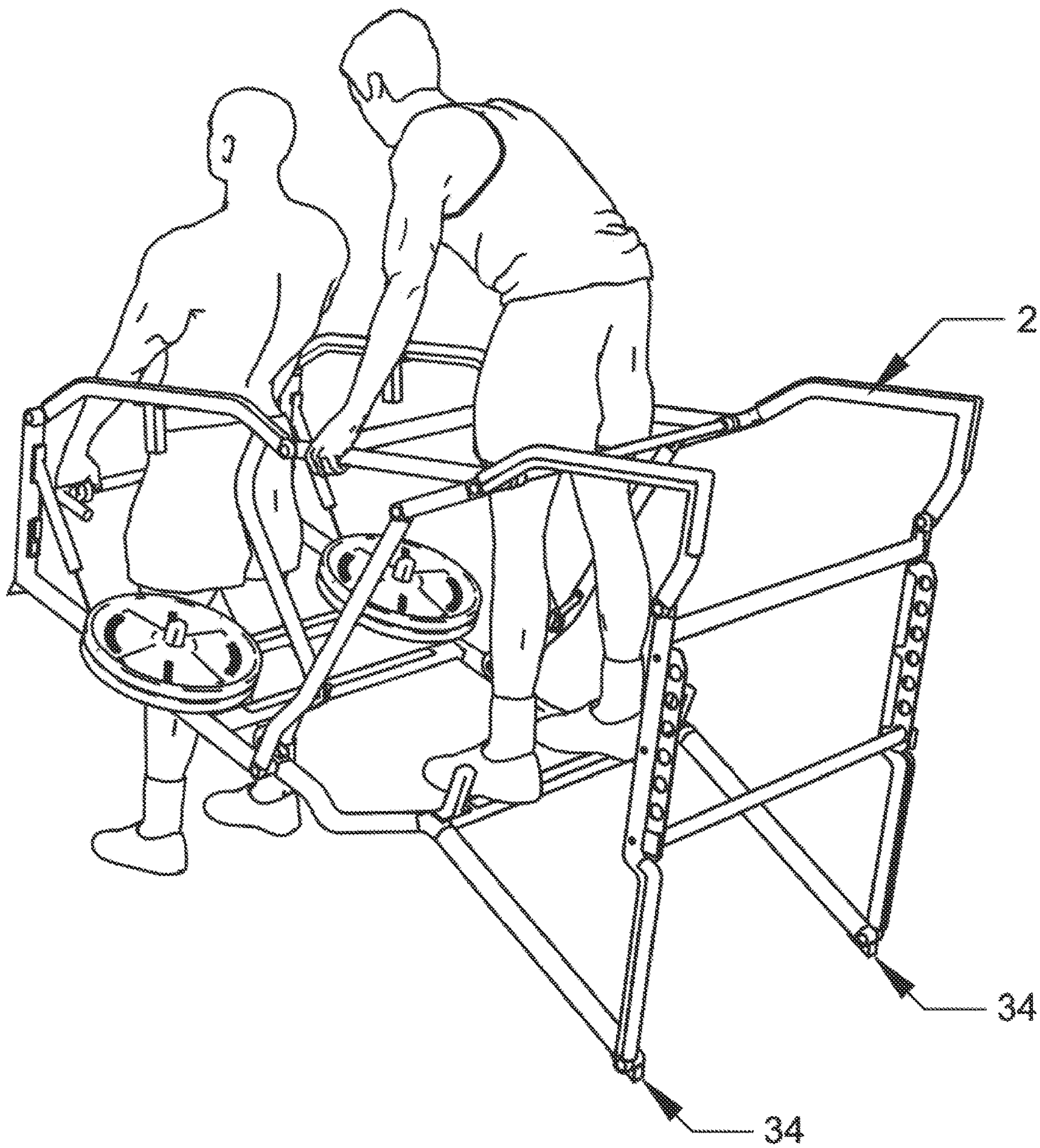
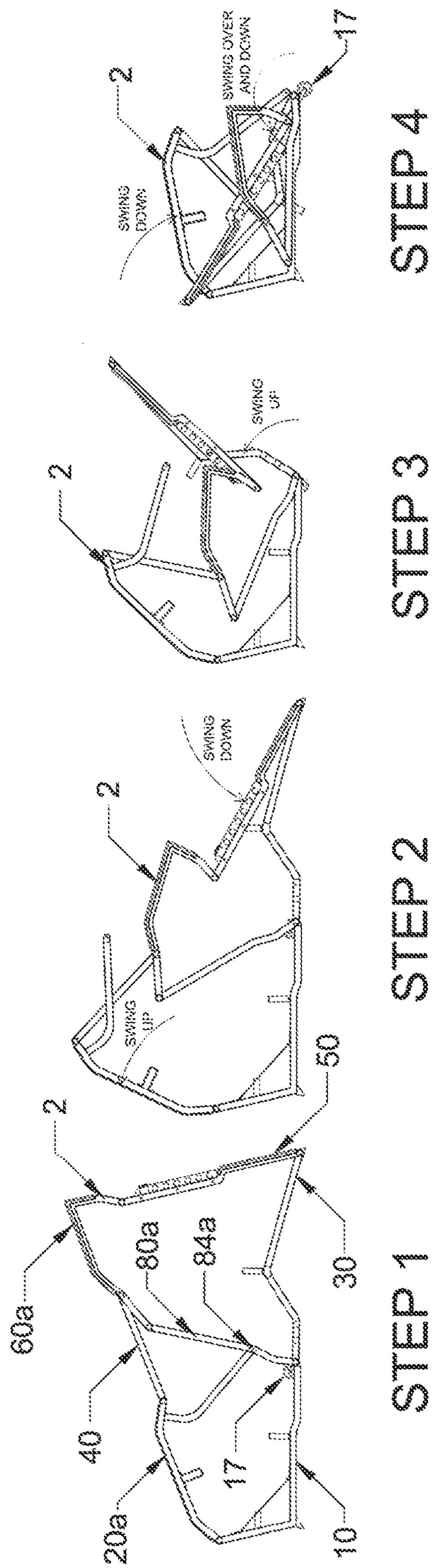
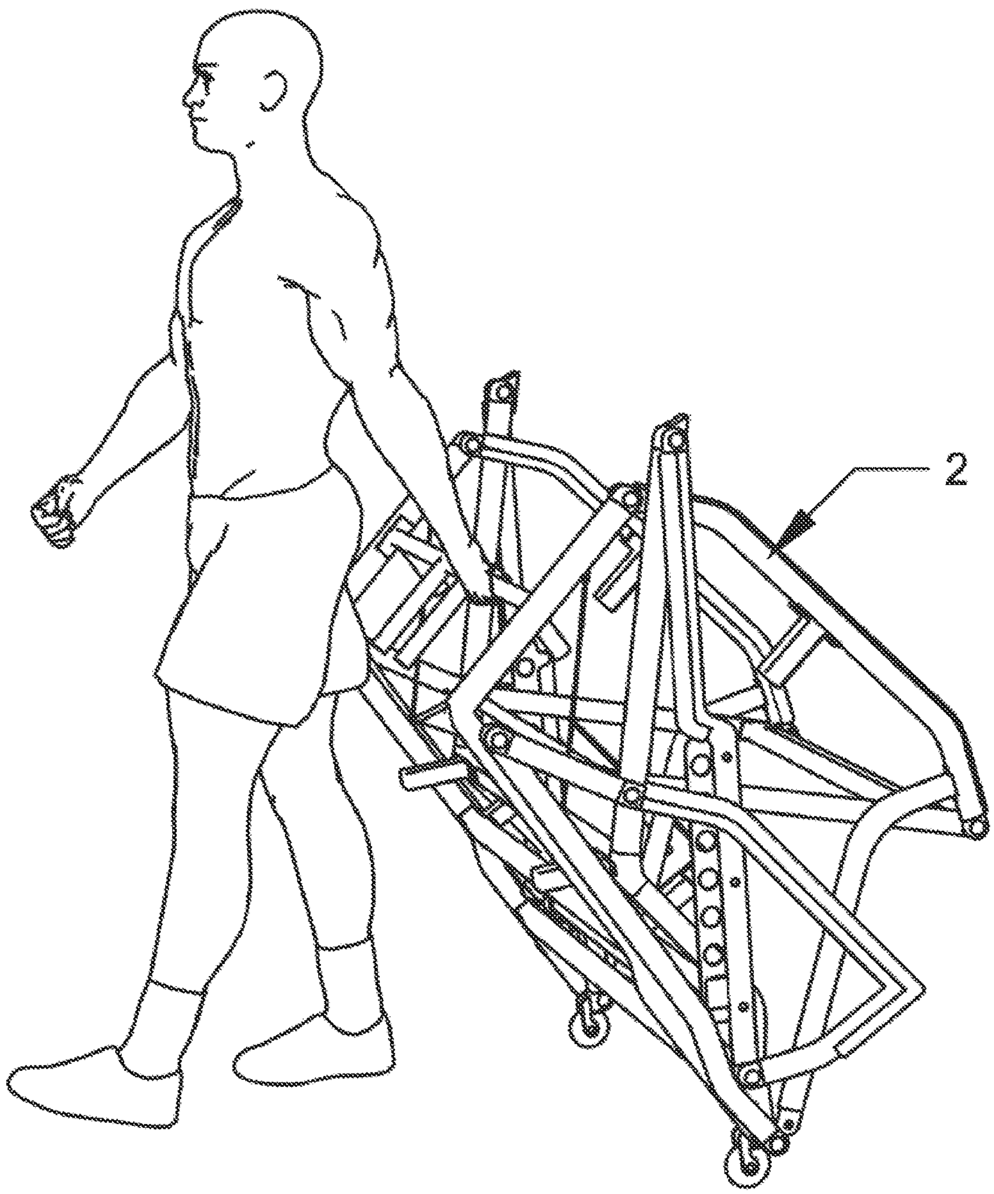


FIGURE 26:



STEP 1
STEP 2
STEP 3
STEP 4
2
60a
80a
84a
40
20a
17
10
30
50
SWING UP
SWING DOWN
SWING OVER AND DOWN

FIGURE 27:



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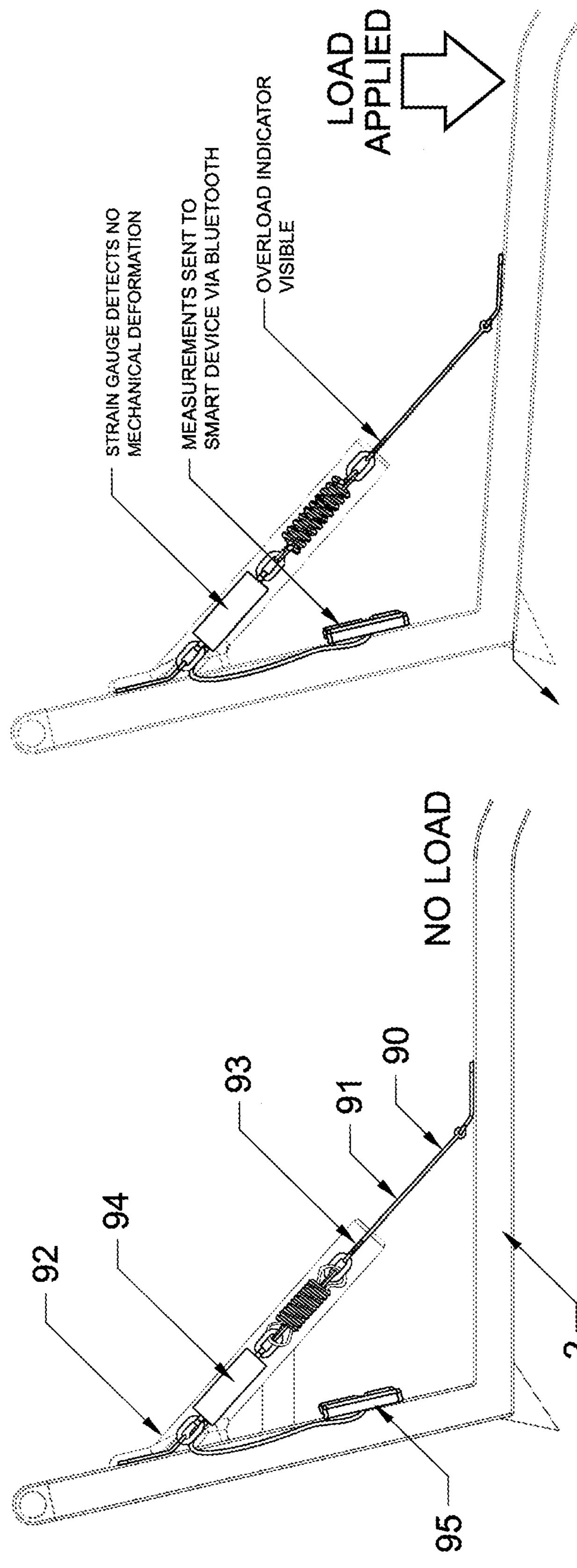


NO LOAD
92
94
93
91
90
2
95
LOAD
APPLIED
STRAIN GAUGE DETECTS NO
MECHANICAL DEFORMATION
MEASUREMENTS SENT TO
SMART DEVICE VIA BLUETOOTH
OVERLOAD INDICATOR
VISIBLE

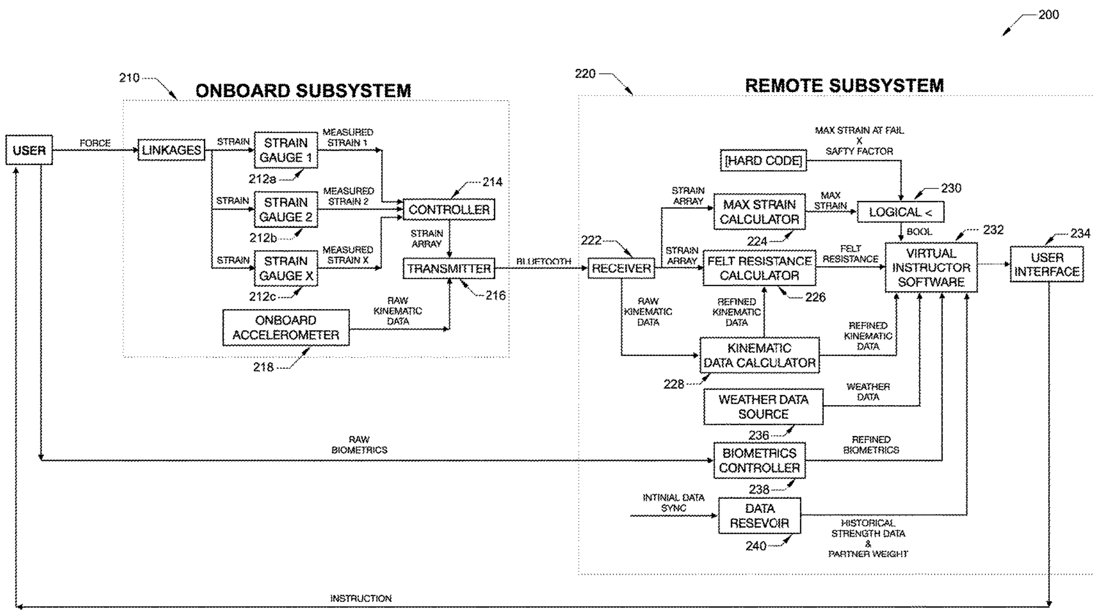

200
210
ONBOARD SUBSYSTEM
220
REMOTE SUBSYSTEM
USER
FORCE
LINKAGES
STRAIN
STRAIN GAUGE 1
212a
MEASURED STRAIN 1
STRAIN
STRAIN GAUGE 2
212b
MEASURED STRAIN 2
STRAIN
STRAIN GAUGE X
212c
MEASURED STRAIN X
CONTROLLER
214
STRAIN ARRAY
TRANSMITTER
216
ONBOARD ACCELEROMETER
218
RAW KINEMATIC DATA
BLUETOOTH
RECEIVER
222
MAX STRAIN AT FAIL X SAFTY FACTOR
[HARD CODE]
STRAIN ARRAY
MAX STRAIN CALCULATOR
224
MAX STRAIN
LOGICAL <
230
BOOL
STRAIN ARRAY
FELT RESISTANCE CALCULATOR
226
FELT RESISTANCE
VIRTUAL INSTRUCTOR SOFTWARE
232
USER INTERFACE
234
RAW KINEMATIC DATA
REFINED KINEMATIC DATA
KINEMATIC DATA CALCULATOR
228
REFINED KINEMATIC DATA
WEATHER DATA SOURCE
236
WEATHER DATA
RAW BIOMETRICS
BIOMETRICS CONTROLLER
238
REFINED BIOMETRICS
INTINIAL DATA SYNC
DATA RESEVOIR
240
HISTORICAL STRENGTH DATA & PARTNER WEIGHT
INSTRUCTION

FIGURE 29:

FIGURE 30:

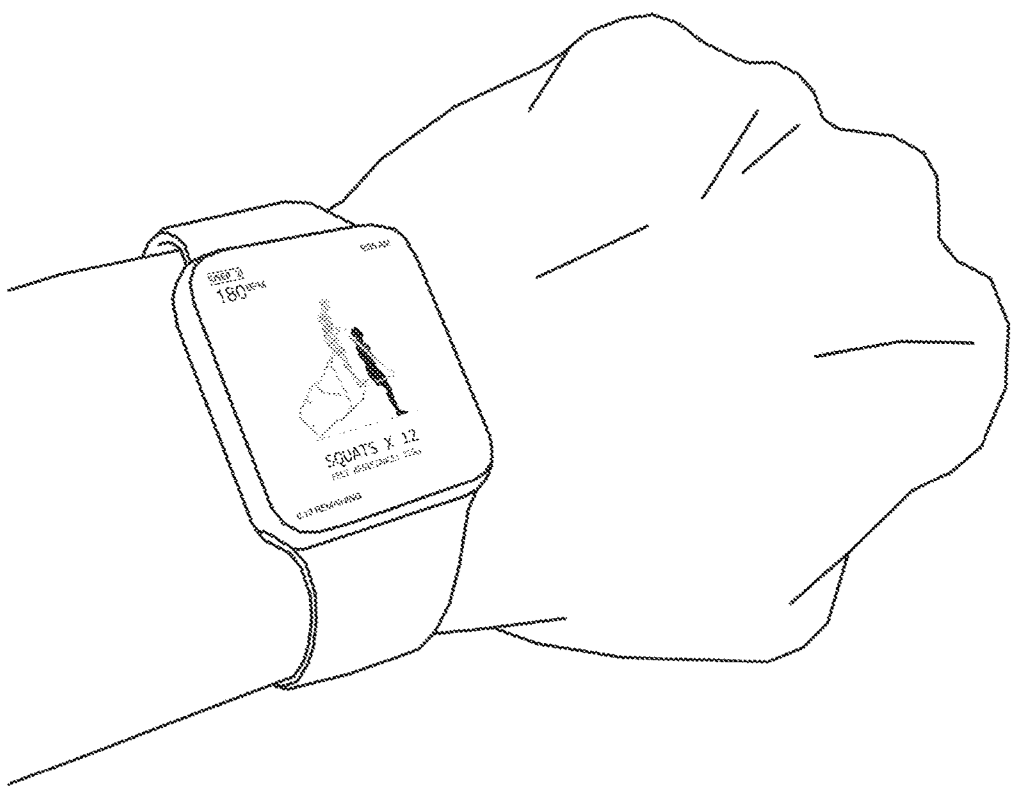


FIGURE 31:

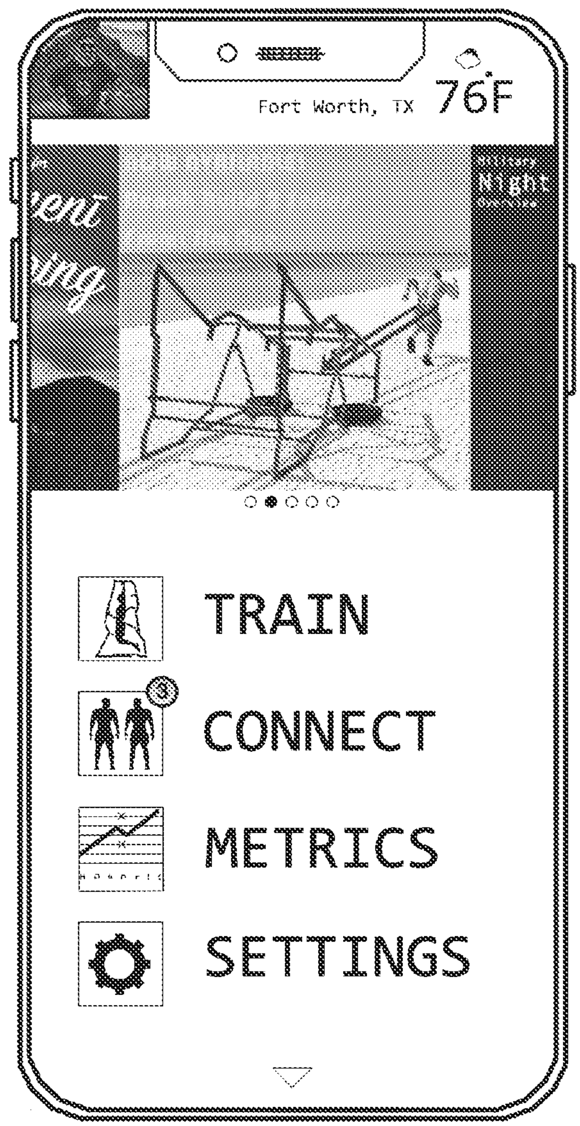


FIGURE 32:

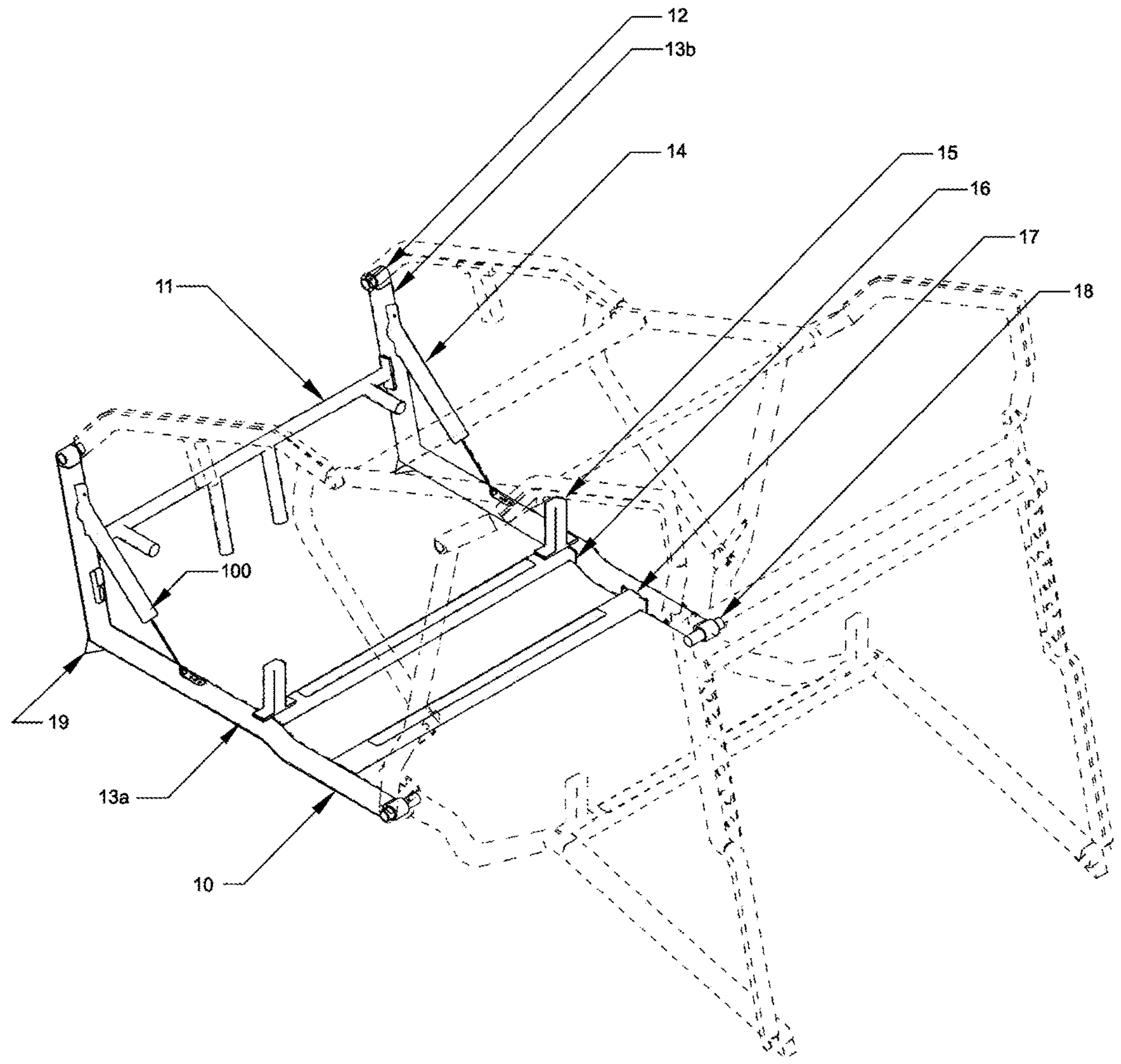


FIGURE 33:

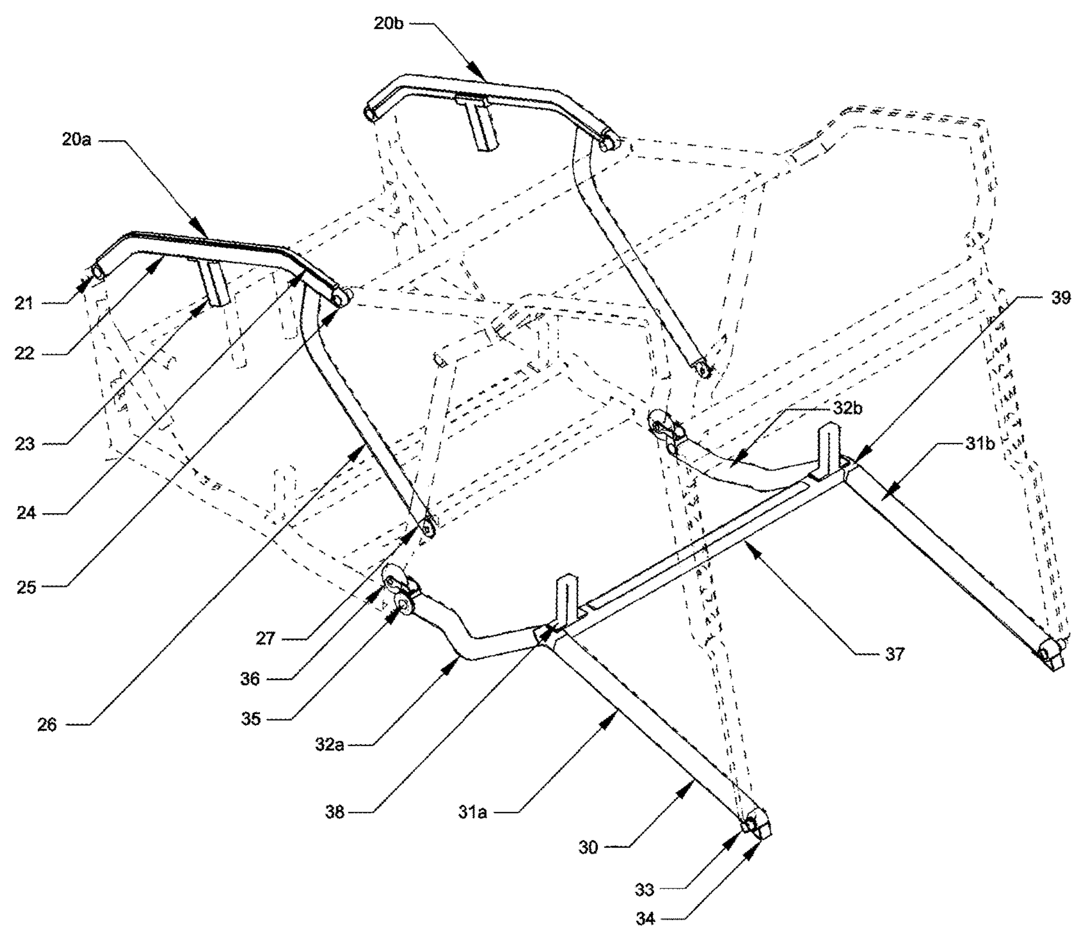


FIGURE 34:

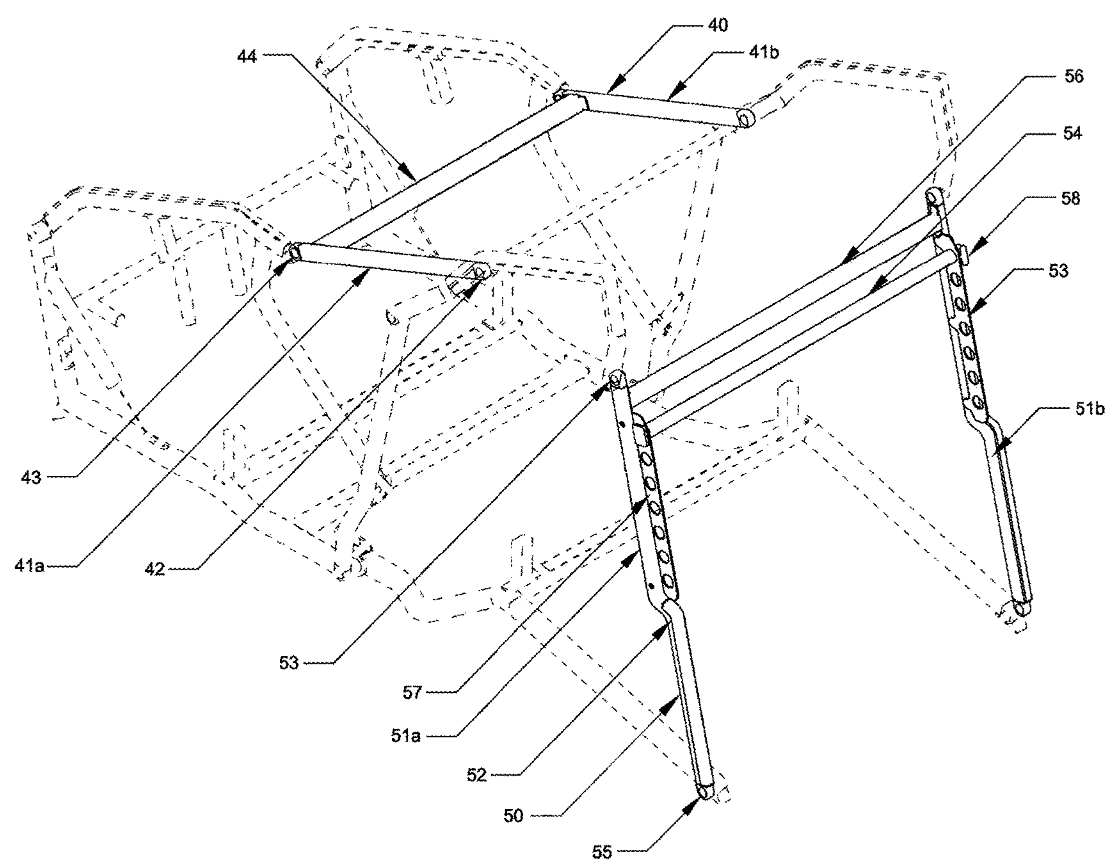


FIGURE 35:

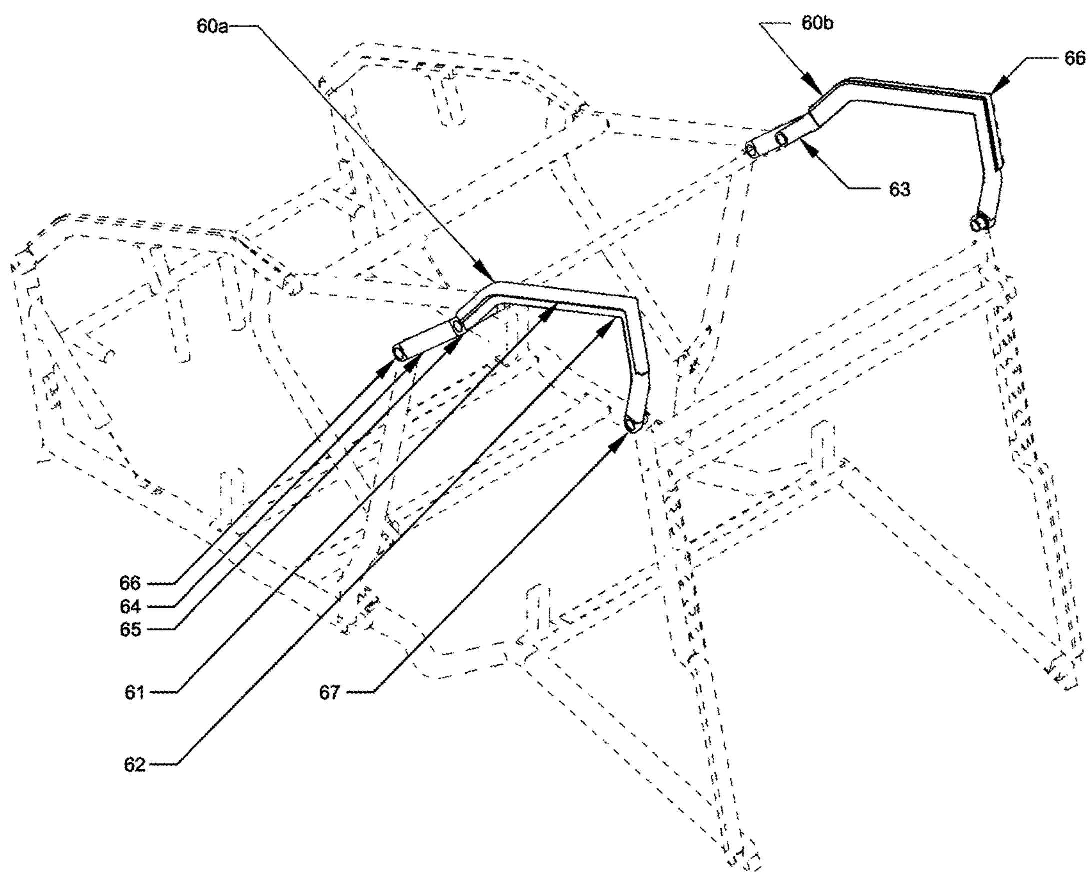


FIGURE 36:

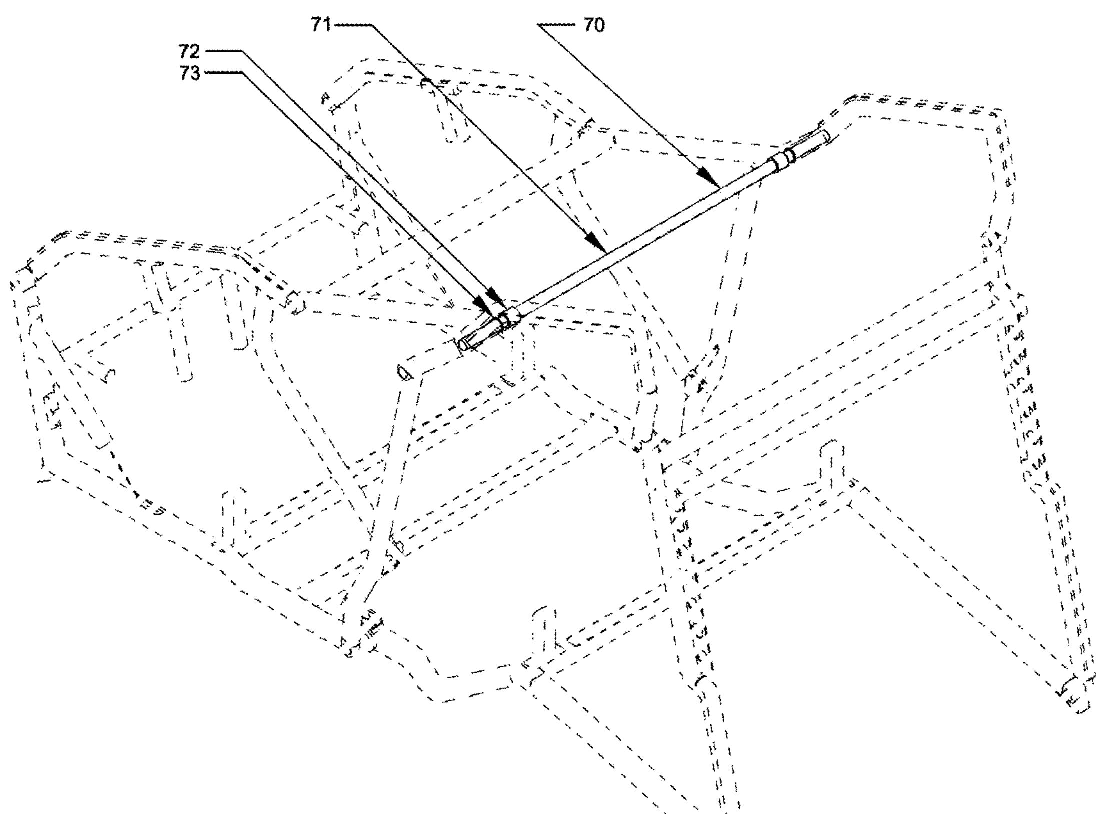


FIGURE 37:

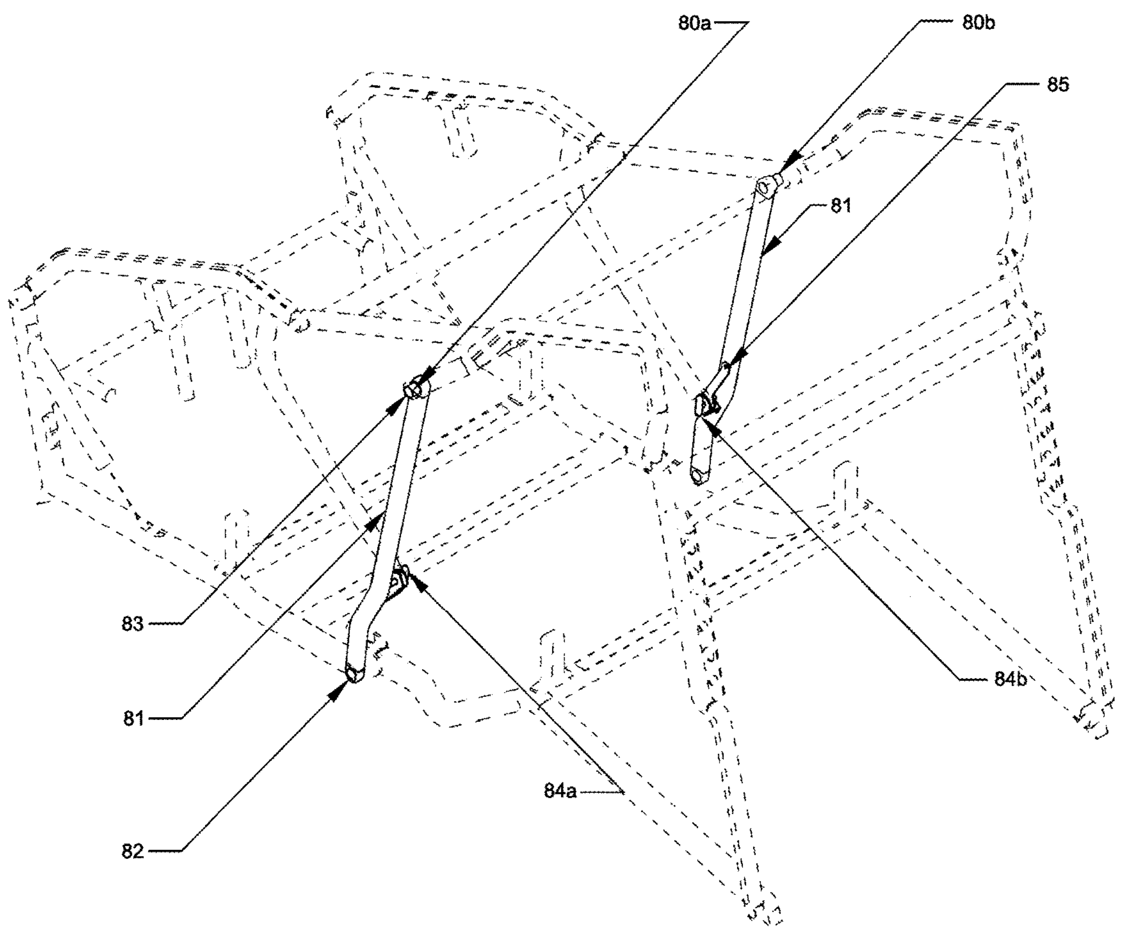


FIGURE 38:

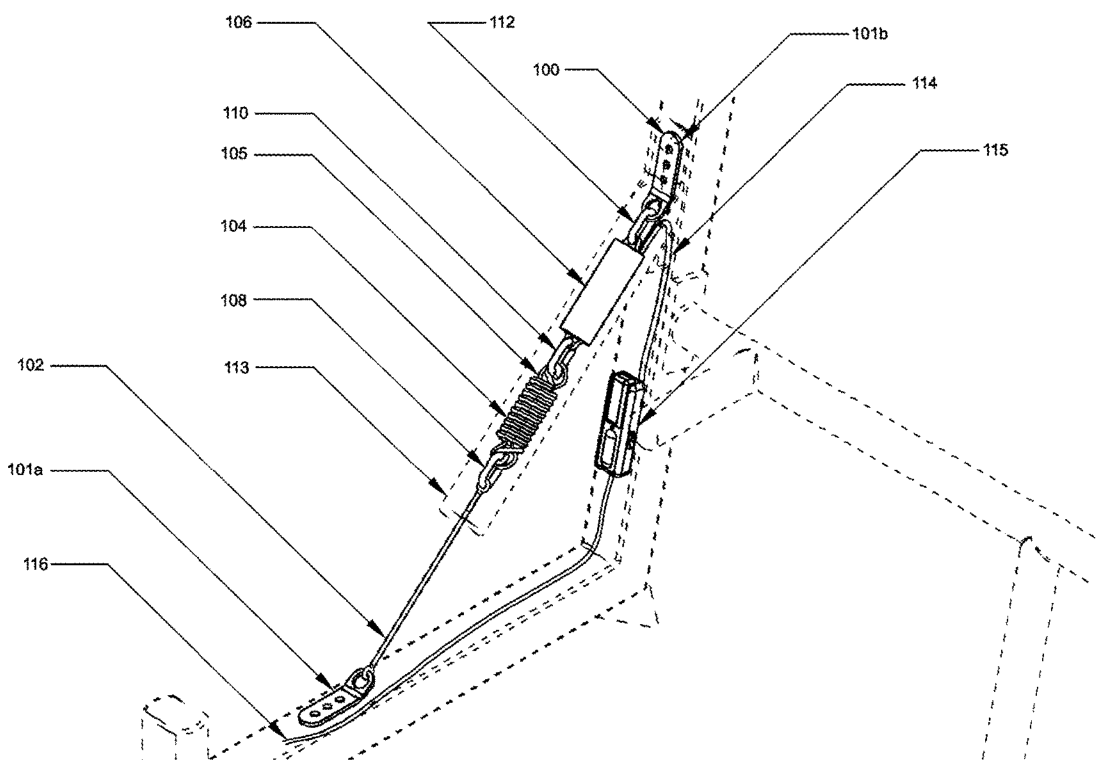


FIGURE 39:

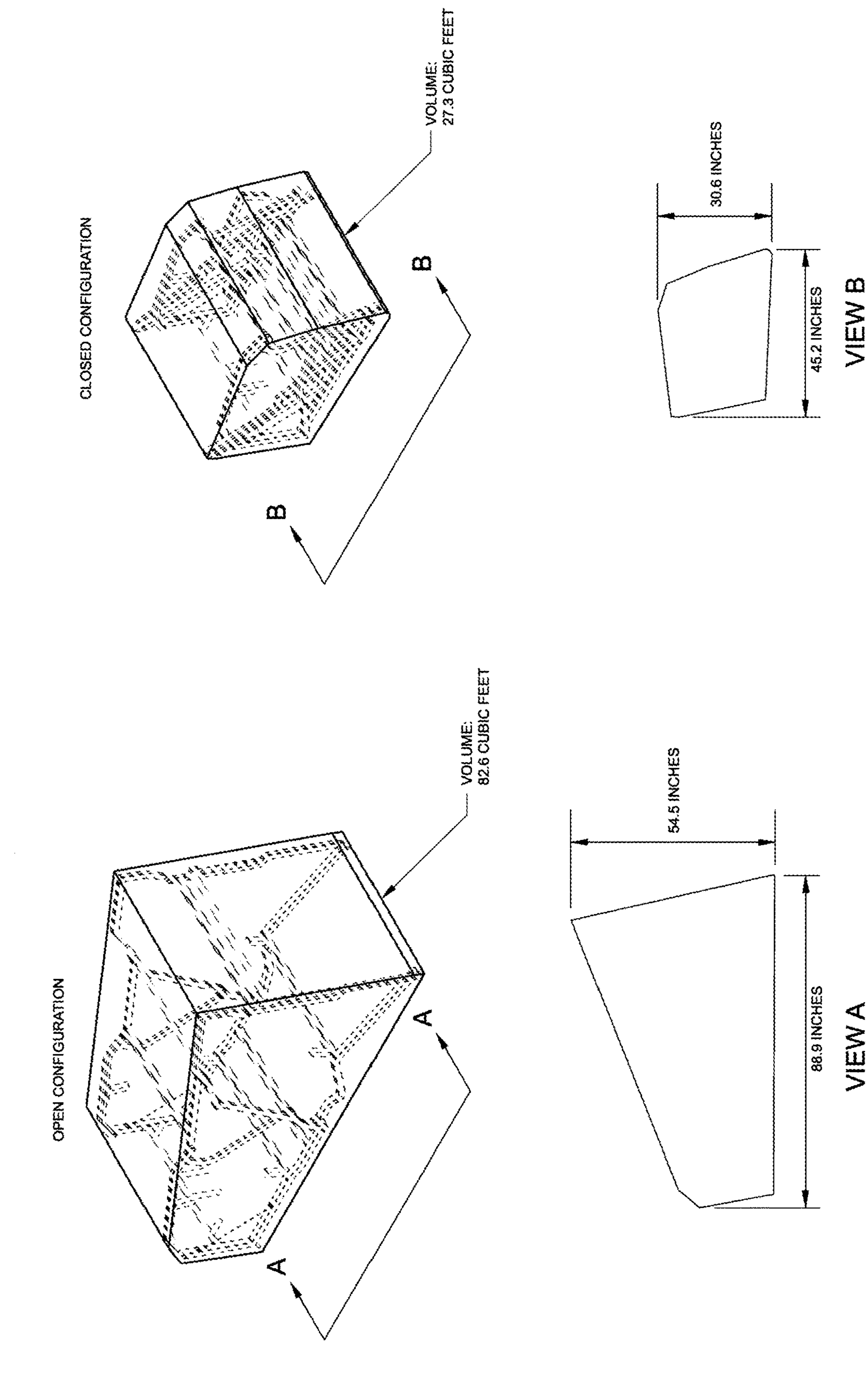
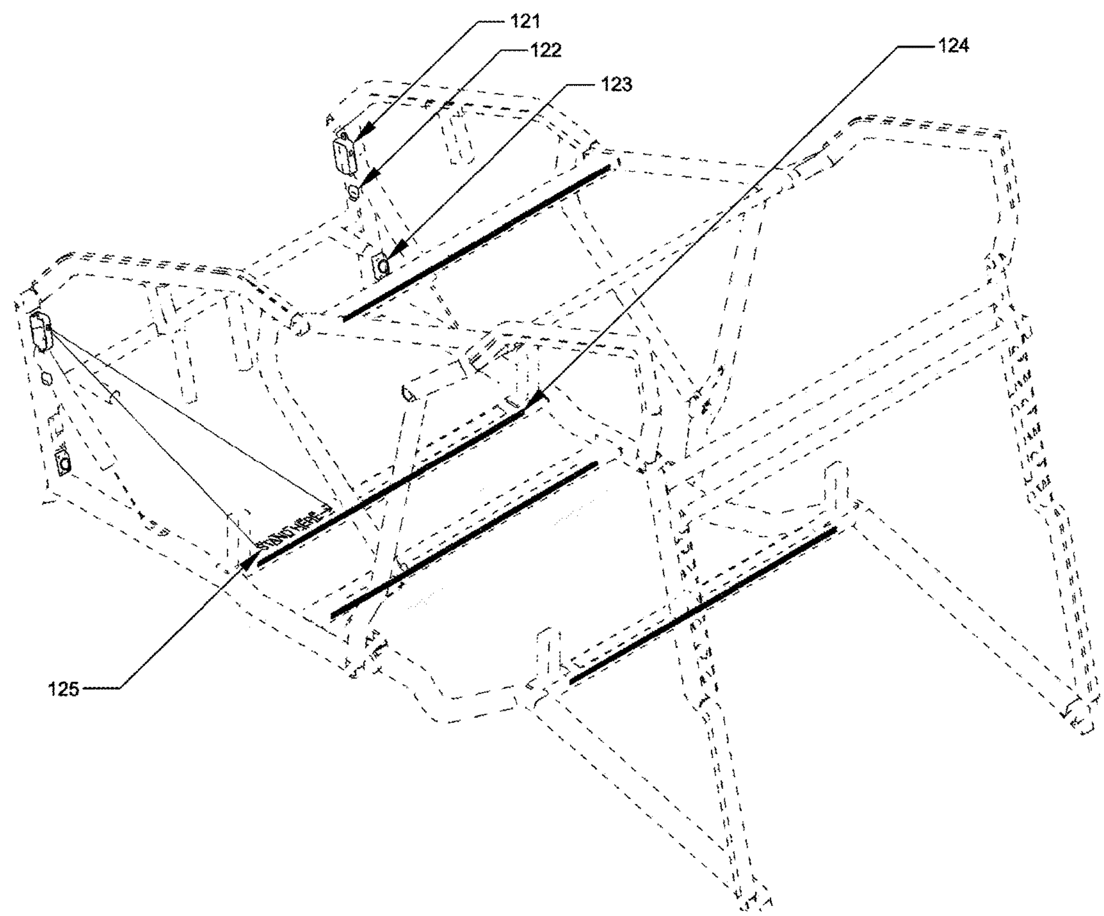

OPEN CONFIGURATION
VOLUME:
82.6 CUBIC FEET
A
A
54.5 INCHES
88.9 INCHES
VIEW A
CLOSED CONFIGURATION
VOLUME:
27.3 CUBIC FEET
B
B
30.6 INCHES
45.2 INCHES
VIEW B

FIGURE 40:



PIVOTING/TILTING MULTIFUNCTIONAL COLLAPSIBLE FITNESS SYSTEM AND ASSOCIATED SOFTWARE

RELATED APPLICATIONS

[0001] This application claims priority to U.S. Patent Application No. 63/262,372, which was filed on Oct. 11, 2021. This prior application is herein incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] The size and weight of high-resistance training equipment make it inherently expensive, bulky, and difficult to transport. This leaves high-resistance training consumers with the options to (a) pay recurring fees to attend gyms, (b) buy expensive equipment themselves to place in a steadfast location, or (c) reduce the resistance and alter the methods with and by which they train. Time and time again, however, science has proven that there is no substitute for high-resistance training in regards to strength improvement, muscle development, and the efficiency of caloric depletion.

[0003] Where heavy, bulky equipment is not available, users typically use their own body weight for exercises (i.e., push-ups, pull-ups, lunges, etc.). But body weight exercises typically result in relatively low-resistance/high-repetition workouts. Ideally, a means would exist that would allow users to utilize their and other's body weight to perform both low-resistance/high-repetition and high-resistance/low-repetition exercises, all while allowing for collaborative and team building workouts.

SUMMARY

[0004] A multifunctional fitness system may provide high-resistance exercises through the distribution of weight upon a frame that pivots on the ground. In particular implementations, while a user lifts one end of the frame, the opposite end pivots. The weight of another person and/or conventional weights can be placed on the frame at various locations to produce the desired leverage and, thus, resistance felt by the lifter. The frame may also have various axes upon which it can pivot and grip points, thus offering a broad range of exercises that can be conducted. Reorienting the frame to be resting on differing sides may result in additional feasible exercises. Optional integrated electronics (typically in conjunction with existing smart devices) may use kinematics and/or structural flexing to calculate felt resistance and provide automated instruction to the various users. The may also collapse into a compact, rollable configuration for easy transport.

[0005] In one general aspect, an exercise system includes a frame having a multitude of linked members. The frame may be configured to be reoriented onto various sides thereof to provide a user with different groups of exercises for each orientation, with at least some of a first group of exercises involving the pivoting of the frame about an end. In some implementations, the first group of exercises may also involve pivoting the frame about a second end.

[0006] In particular implementations, the frame has three orientations in which exercises may be performed, each with its own group of exercises. A second group of exercises may, for example, involve pivoting the frame about a different end than the first group of exercises. Additionally, at least some of the second group of exercises may involve sliding of the frame on the ground. The frame may be configured to resist sliding on the ground for the first group of exercises and/or to assist sliding on the ground for at least some of the second group of exercises. In certain implementations, the frame has a bottom side, a back side, and a front side, and the orientations of the frame include upright, on its back, and on its front.

[0007] The frame may, for example, include a base, a vertical section, and a top section when in an upright orientation. The vertical section may be hingedly attached to the base and/or hingedly attached to the top section. In particular, implementations, the base may include two portions that are hinged to each other.

[0008] The frame may be configured to support a person such that the person acts as a weight for a number of exercises. In certain implementations, the frame may be configured to support a person at multiple locations such that the resistance felt by a user is altered.

[0009] The frame may also be configured to collapse along a single degree of freedom. In certain implementations, the frame may collapse to less than one-half of its expand volume, and in some implementations, the frame may collapse to less than one-third of its expanded volume.

[0010] The system may also include a mechanical overload indicator coupled to the frame. Additionally, the system may include a mechanical exertion level indicator coupled to the frame.

[0011] The system may further include integrated electronics coupled to the frame to detect strain thereon and a transmitter to wirelessly send the detected strain to a remote computing device. The computing device may be configured to receive the strain indications and determine an exertion level for the exercise being performed. The compute device may also be configured to provide exercise instructions to a user. In some implementations, the computing device may be attached to the frame.

[0012] In certain implementations, the system includes light emitting electronics integrated into the frame to provide instruction and safety features for the exercise being performed. The system may also include audio electronics integrated into the frame to provide instruction and safety features for the exercise being performed.

[0013] Various implementations may include one or more features. For example, an exercise system may provide a multitude of strength building exercises of varying resistance for both arms and legs without having to rely on conventional weights. Among other things, this may allow the exercise system to be used by users of varying strength and make the exercise system more portable. As another example, an exercise system may provide an indication of exerted effort (e.g., force) even if conventional weights are not being used. As an additional example, an exercise system may be collapsible into an easily storable and/or transportable configuration. Additional features will be evident to those skilled in the art in light of the following written description and figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] For a more complete understanding of the present invention and its implementations, and the features thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

[0015] FIG. **1** is a line drawing illustrating an example exercise system in accordance with one implementation of the invention.

[0016] FIG. **2** illustrates different orientations in which the exercise system of FIG. **1** may be used.

[0017] FIG. **3** illustrates the exercise system being used for squats.

[0018] FIG. **4** illustrates the exercise system being used for leg presses.

[0019] FIG. **5** illustrates the exercise system being used for shoulder presses.

[0020] FIG. **6** illustrates the exercise system being used for deadlifts.

[0021] FIG. **7** illustrates the exercise system being used for bent-over rows.

[0022] FIG. **8** illustrates the exercise system being used for upright rows.

[0023] FIG. **9** illustrates the exercise system being used for bicep curls.

[0024] FIG. **10** illustrates the exercise system being used for overhead tricep extensions.

[0025] FIG. **11** illustrates the exercise system being used for shoulder shrugs.

[0026] FIG. **12** illustrates the exercise system being used for dips.

[0027] FIG. **13** illustrates the exercise system being used for pull-ups.

[0028] FIG. **14** illustrates the exercise system being used for leg-assisted pull-ups.

[0029] FIG. **15** illustrates the exercise system being used for sled pushes.

[0030] FIG. **16** illustrates the exercise system being used for sled pulls.

[0031] FIG. **17** illustrates the exercise system being used for hanging rows.

[0032] FIG. **18** illustrates the exercise system being used for bench press.

[0033] FIG. **19** illustrates the grip optionality when the exercise system is being used for deadlifts.

[0034] FIG. **20** illustrates the grip optionality when the exercise system is being used for different types of pull-ups.

[0035] FIG. **21** illustrates the exercise system being used for deadlifts utilizing multiple people for resistance.

[0036] FIG. **22** illustrates the exercise system being used for deadlifts utilizing weighted plates for resistance.

[0037] FIG. **23** illustrates the exercise system being used for squats utilizing weighted plates for resistance.

[0038] FIG. **24** illustrates the exercise system being used for sled pushes utilizing weighted plates for resistance.

[0039] FIG. **25** illustrates the exercise system being used for deadlifts utilizing both weighted plates and a person for resistance.

[0040] FIG. **26** illustrates the collapsibility of the exercise system of FIG. **1**.

[0041] FIG. **27** illustrates the portability of the exercise system of FIG. **1**.

[0042] FIG. **28** illustrates a load determination assembly for an exercise system similar to that in FIG. **1**.

[0043] FIG. **29** is a block diagram illustrating a load determination system and software architecture for an exercise system.

[0044] FIG. **30** is a line drawing illustrating a virtual instructor for an exercise system.

[0045] FIG. **31** illustrates a user application for use with an exercise system in accordance with the present invention.

[0046] FIG. **32** highlights several components used when utilizing an exercise system in accordance with the present invention for deadlifts.

[0047] FIG. **33** highlights several components used when utilizing an exercise system in accordance with the present invention for sled pushes.

[0048] FIG. **34** highlights several components used when utilizing an exercise system in accordance with the present invention for squats.

[0049] FIG. **35** highlights several components used when utilizing an exercise system in accordance with the present invention for sled pushes.

[0050] FIG. **36** highlights a structural component for the system.

[0051] FIG. **37** highlights a structural component for collapse functionality.

[0052] FIG. **38** highlights a load determination assembly.

[0053] FIG. **39** illustrates example dimensions for an expanded and collapsed exercise system in accordance with the present invention.

[0054] FIG. **40** illustrates example electronics and their function for an exercise system similar to that in FIG. **1**.

DETAILED DESCRIPTION

[0055] While the inventive concepts are much more basic than any particular implementation, those skilled in the art can gather a partial appreciation for some of the possible benefits of the broader concepts and possible interplay between various elements of the concepts in the course of considering example implementations, some of which are described in detail below.

[0056] FIG. **1** illustrates an example exercise system **1**. In one aspect, system **1** allows for high-resistance exercises through the distribution of one's own body weight and/or that of another upon a frame **2**.

[0057] As shown, frame **2** is composed of a number of hinged linkage structures that allow the frame to collapse (to be discussed in more detail below) into a volume that is less than 50% of its expanded volume and, in some cases, less than 33%. The linkage structures include a deadlift linkage assembly **10**, left and right sled linkage assemblies **20***a*, **20***b*, a dip standing linkage assembly **30**, a sled connector linkage assembly **40**, a squat linkage assembly **50**, left and right dip sled linkage assemblies **60***a*, **60***b*, a spanning rod assembly **70**, and left and right dip connector assemblies **80***a*, **80***b*.

[0058] In operation, frame **2** has three use orientations that are yielded from rotating the frame along its edges to rest on different faces as demonstrated in FIG. **2**. Each of these orientations (labeled A, B, C) allow for a different group of feasible exercises to be performed by a user. In Orientation B, squat linkage assembly **50** and dip sled linkage assemblies **60** provide a base for frame **2**, dip standing linkage assembly **30** provides a vertical section for frame **2**, and deadlift linkage assembly **10** provides a top section for frame **2**. These assemblies serve different roles in Orientation A and Orientation C.

[0059] Orientation A provides two pivot axes **19**, **34**, on the far left and far right of the system as viewed in FIG. **2**. As a pivot axis is stationary on the ground, the user (lifter) lifts the opposite end of the frame, lifting the leverage weight thereof. Between the lifter and the pivot axis, the weight of another person ("liftee") or one or more weighted plates may be placed on the structure in a location yielding the desired leverage and, thus, resistance felt by the lifter. Additionally, the resistance offered by a liftee or weight plate may be adjustable by varying the location of the frame—the further the liftee is from the pivot axis, the greater the felt resistance by the lifter.

[0060] On the end where pivot **19** is located in Orientation A is a bar (not viewable here) at about shin height for conventional “over-the-bar” lifts whose design allows for both straight and parallel grips (see FIG. **19**). And on the end where pivot **34** is located in Orientation A is a height-adjustable bar (not viewable here) for “under-the-bar” lifts. Given these two bars, their respective pivot axes, and the general location of linkage members in this orientation, variations of the following exercises can be conducted:

[0061] Squats (FIG. **3**)

[0062] Leg Press (FIG. **4**)

[0063] Shoulder Press (FIG. **5**)

[0064] Deadlifts (FIG. **6**)

[0065] Bent-Over Rows (FIG. **7**)

[0066] Upright Rows (FIG. **8**), utilizing a strap fixed to the frame

[0067] Biceps Curls (FIG. **9**), utilizing a strap fixed to the frame

[0068] Over-Head Tricep Extensions (FIG. **10**), utilizing a strap fixed to the frame

[0069] Shrugs (FIG. **11**)

[0070] Dips (FIG. **12**), utilizing removable load-bearing members (e.g., bars)

[0071] Orientation B is yielded from rotating the frame about pivot **34** so that it rests on the side/face of the height-adjustable bar as seen in FIG. **2**, resulting in a taller structure. The bar previously at shin height in Orientation A is elevated higher in Orientation B, thus allowing for variations of the following exercises:

[0072] Pull-Ups (FIG. **13**)

[0073] Leg-Assisted Pull-Ups (FIG. **14**)

[0074] The bar onto which the user holds for these exercises is configured in a manner in which various grip orientations are permitted as seen in FIG. **20**.

[0075] Orientation C is yielded from rotating the mechanism about pivot **66** in Orientation B so that the Orientation A pivots **19**, **34** are pointed upward as seen in FIG. **15**. On one end of the mechanism in Orientation C, the left side as viewed in FIG. **2**, pivot **66** allows the opposite end to be functionally lifted. However, the other linkages contacting the ground in Orientation C are angled as to allow the sliding of the mechanism in one direction (i.e., to the right in Orientation C). These features and the general location of the linkage members in this orientation allow variations of the following lifts to be conducted:

[0076] Sled Push (FIG. **15**)

[0077] Sled Pull (FIG. **16**), utilizing a large strap

[0078] Hanging Rows (FIG. **17**)

[0079] Bench Press (FIG. **18**), utilizing a narrow elevated surface

[0080] A feature of system **1** is that a liftee may be positioned at different locations on frame **2**. For example, in FIG. **3**, the liftee is shown as standing on an intermediate horizontal member in Orientation A. However, the liftee could be positioned on the horizontal member immediately behind the lifter, thus increasing resistance, or positioned on the horizontal member farther from the lifter, thus decreasing resistance. Thus, system **1** allows users of different sizes to work out with each other. Moreover, one liftee can provide varying resistance to a lifter.

[0081] When placement of the liftee at maximum distance from the pivot axis for an exercise still yields an inadequate amount of resistance felt by the lifter, the system allows for additional weight to be applied. For example, the frame may be designed and strengthened as to allow multiple persons to distribute their weight simultaneously on the frame for greater resistance, as illustrated in FIG. **21**. When persons are not available to serve as the liftee, plate mounts are also integrated to allow the use of weighted plated as the primary means of resistance, as seen in FIGS. **22**, **23**, and **24**. Weighted plates and liftee(s) can be used in conjunction if needed, as seen in FIG. **25**.

[0082] A feature of the system **1** is its ability to be transported easily. The linkage system of frame **2**, for example, has one degree of freedom when unlocked, allowing it to collapse into a closed/condensed configuration. In particular, with the removal of just two pins **84***a*, **84***b*, the linkage design can collapse into the closed configuration as illustrated in FIG. **26**, to allow for transport and/or storage in confined areas. Certain implementations, however, may use different locking mechanisms or may not collapse at all.

[0083] To collapse frame **2** when it is fully expanded and locked, pins **84***a*, **84***b* are removed (Step **1**). Then, sled linkage assemblies **20** (only one of which is viewable in FIG. **26**) are swung outward relative to deadlift linkage assembly **10** (counterclockwise in FIG. **26**), which causes sled connector linkage assembly **40** to pull dip sled linkage assemblies **60**, squat linkage assembly **50**, and dip connector assemblies **80** towards deadlift linkage assembly **10** (Step **2**). Next, dip standing linkage assembly **30** is swung towards deadlift linkage assembly **10** (counterclockwise in FIG. **26**), moving dip sled linkage assemblies **60**, squat linkage assembly **50**, and dip connector assemblies **80** inside deadlift linkage assembly **10** (beginning in Step **3** and ending early in Step **4**). Then, sled linkage assemblies **20** are swung back toward deadlift linkage assembly **10**, completing the collapse (Step **4**).

[0084] In particular implementations, frame **2** may be locked into place when collapsed. For example, most any of the linkage members that are close to each other may be coupled (e.g., pinned) together. In certain implementations, the members that were pinned in the expanded configuration may be pinned together in the collapsed configuration, Compare Step **1** with Step **4** FIG. **26**.

[0085] During the collapse process, wheels **17** may emerge from one side of the frame allowing it to be easily rolled, as illustrated in FIG. **27**. (The wheels are present in FIG. **1**, but are hidden by various members due to the chosen perspective.)

[0086] As a safety measure, a mechanical overload indicator **90** may be built into an exercise system, as illustrated in FIGS. **1** and **28**. Overload indicator **90** includes a cable-spring assembly **91** placed on frame **2** so that flexion thereof under loads will place the cable and spring (connected in series) under tension. A shroud **92** covers the spring and part of the cable in a manner such that an overload indicator **93** (e.g., a marked portion of the cable) is hidden in an unloaded condition. Under load, however, the flexion of the frame yields in the exposure of more of the cable. Indicator marking **93** is placed on the cable so that the maximum allowed load will result in the marking’s visibility from under shroud **92**, thus indicating applied force should be reduced (see FIG. **28**). Utilizing the same principle, incremental ticks on the cable may allow for felt resistance estimations.

[0087] An exercise system may also have integrated electronics that allow for more functionally precise means of determining felt resistance. Placed in series with the cable/spring assembly **91** in FIG. **28**, for example, is a strain gauge **94**. An instrumentation-driver/battery/transmitter assembly **95** gathers the strain measured by the strain gauge during the frame's flexion under load as seen in FIG. **28**. Additionally, in certain embodiments, onboard accelerometers may gather kinematic data. Gathered information is sent via a transmitter (e.g., via Bluetooth or Zigbee) to a user's smart device (e.g., a lifter's smart phone, smart watch, or tablet) where algorithms are used to calculate the maximum strain, felt resistance, cadence, etc. Smart devices may not only display the calculated data but store the data as well. Storing records of the conducted exercises, user's felt resistance, lifting cadences, and other available biometric data allows for a "virtual instructor" within software onboard the associated smart device to plan and guide the users' workouts through visual and auditory means, as shown in FIG. **30**.

[0088] A general layout of example elements for a load determination system architecture **200** is seen in FIG. **29**. In particular implementations, the "virtual instructor" software may be onboard a computer integrated in the mechanism itself rather than utilizing a user's smart device as the software driver.

[0089] Load determination system architecture **200** includes a subsystem **210** onboard the frame and a remote subsystem **220**. In particular implementations, all or a portion of remote subsystem **220** may be onboard the frame.

[0090] Onboard subsystem **210** includes a number of strain gauges **212**. Strain gauges **212** may be mounted on the same frame member and/or different frame members. If mounted on the same member, the strain gauges may measure strains in different axes.

[0091] Coupled to strain gauges **212** is a controller **214**. Controller **214** is typically an electronic logic device (e.g., a microcontroller) and is responsible for receiving the readings from the strain gauges (usually in analog form) and preparing them for further analysis (e.g., by converting them to digital form).

[0092] The prepared data is sent via a transmitter **216** to remote subsystem **220**. Transmitter **216** typically works by wireless techniques (e.g., radio frequency), but could use wired techniques in certain implementations.

[0093] Onboard subsystem **210** also includes an accelerometer **218**, which can measure the motion (e.g., acceleration) that frame **2** is subjected to. The data from accelerometer is also sent to transmitter **216**.

[0094] Remote subsystem **220** may be a smartphone, a tablet, or any other appropriate electronic logic device (e.g., having an electronic processor, memory, and input/output capability). Remote subsystem **220** may only be remote in the aspect that it is connected to onboard subsystem **210** through a communication link, as opposed to being at some large geographic distance from it. In some operations, remote subsystem **220** may actually be on or inside the periphery of the frame.

[0095] Remote subsystem **220** includes a receiver **222** for receiving data from transmitter **216**. The data is then fed to the appropriate calculator (e.g., an electronic logic device or a piece of code operating on an electronic logic device). For example, data from the strain gauges may be fed to a strain calculator **224**, which may determine the actual strain occurring on the system. The actual strain may be compared to the maximum allowable strain via a comparator **230** to make sure the frame is not being overtaxed. As another example, data from the strain gauges may be fed to a resistance calculator, which may determine how much resistance (e.g., weight) is being felt by the user. The amount of axial strain on a linear member is, for example, proportionally related to the force axial applied thereto. Depending on the size and location of a liftee, the resistance felt by a lifter can vary greatly. Thus, being able to determine the effective resistance, provides the lifter with some idea of what and how they are doing with the particular exercises. Kinematic data may be fed to a kinematic data calculator **228**, which may use the acceleration data from the accelerometer **218** to qualify the movement, orientation, and displacement of the mechanism.

[0096] A virtual instructor **232** may use software algorithms to combine, compare, reconcile, and analyze the incoming data (from **224**, **240**, **226**, **228**, **236**, **238**, and/or **240**) to determine real-time instructions to optimize use of the system. Based on the analyzed data, the virtual instructor **232** may provide those determined instructions to the lifter (e.g., increase repetitions, decrease repetitions, reposition liftee, add weight plates, alter cadence, etc.). The instructions may be communicated via a user interface **234**, which may be visual, auditory, or a combination of both. The user may receive the instructions and make appropriate adjustments.

[0097] In some implementations, a user may be wearing a biometric tracker (e.g., an exercise monitor, whether wrist, torso, or otherwise attached). If so, biometrics (e.g., heart rate) may be provided to the virtual software instructor (e.g., via Bluetooth). The virtual software instructor may take the biometric readings into account when providing instructions (e.g., increase or decrease cadence).

[0098] Additionally, remote subsystem **220** may include a weather data source **236**. Current weather conditions (e.g., temperature, humidity, etc.) may be taken into account by the virtual instructor software in providing instructions to the user.

[0099] The associated smart device application may also serve various functions in addition to that of a virtual instructor. The application may, for example, allow for connection and data sharing between users in the mechanism's user community. Users can connect with others based on exercise styles, strength and ability, geographic location, schedule, and experiences. See FIGS. **31**.

[0100] An exercise system may also have additional integrated electronics (e.g., lights, lasers, and/or speakers) that provide both operational and instructional functionality. FIG. **40** illustrates an example integrated electronics. In this implementation, the electronics include laser light projectors **121**, single lights **122**, speakers **123**, and strip lights **124**. Other implementations may include fewer, additional, and/or a different arrangement of electronics.

[0101] During use of the mechanism, the lift point on which the "lifter" grabs and/or the member on which the "liftee" stands to yield the desired felt resistance can be further highlighted through the illumination of lighting elements (e.g., single light **122** or strip lights **124**) mounted on or adjacent to the respective members and/or through laser light projectors **121** projecting onto those respective members or components. Laser lights **121** would also allow for the projection of graphics and text onto mechanism members and/or the ground to provide more redundant instruction **125** and help mitigate unintentional misuse. Lighting elements also can be incorporated into the load determination system to more redundantly alert users when the system is over strained. Speakers **123** could provide verbal instruction, auditory warnings, and other audio material from the software application or of the user's choosing (e.g., music).

[0102] Frame **2**, shown in FIG. **1**, may be made of various materials. For example, the frame may be made of aluminum, polymer, or composite. Differing loads on frame members may result in these differing members being made from different materials to accommodate these higher or lower or different types of (e.g., compression, tension, torsion, shear, etc.) loads. In particular implementations, certain members may be replaced with I-beam members (e.g., composed of a light polymer, such as one with a metal exoskeleton or a glass-filled nylon with a metal endoskeleton). The frame connectors and hinges may be made of aluminum or steel and may be made by machining (e.g., CNC) or cast. It is possible that frame connectors or hinges subjected to lower loads could be made of polymer. Under circumstances where polymer is a satisfactory material for both the connector or hinge and the associated member onto which it is mounted, the components can be integrated together as a single polymer hinge-member or connector-member part and may be made by injection molding. High strength members (e.g., the deadlift bar) may be made of steel (e.g., stainless). Paint and finish may be applied to the mechanism as appropriate to mitigate corrosion.

[0103] As mentioned above, frame **2** is made from various subassemblies. Considering the interconnected nature of the design, all major components are, to an extent, load bearing, have structural ramifications on other members, and impact joint paths during collapse. Detailed below are the aspects unique to each subassembly, for a particular implementation.

[0104] FIG. **32** illustrates an example of deadlift linkage assembly **10**. Deadlift linkage assembly **10** includes a deadlift bar **11**, a subframe composed of side frame members **13** and cross members **16**, **17**, squat pivots **19**, plate posts **15**, and hinges **12**, **18**.

[0105] Deadlift bar **11** is typically made from steel bars that have been cut, welded, and textured. Deadlift bar **11** serves as a lift point in Orientation A (FIG. **6**), the pull-up bar in Orientation B (FIG. **14**), and a lift point in Orientation C (FIG. **18**).

[0106] The subframe composed of side frame members **13** and cross members **16**, **17** is typically made from aluminum tubing that is bent, cut, -welded, and affixed together. Side frame members **13** and cross members **16**, **17** could be made of other suitable materials (e.g., polymers) in other implementations as long as they satisfied the loading requirements, although weight and cost would be additional factors. Cross members **16**, **17** span the assembly and provide an area where a person or persons can stand in order to provide resistance for exercises when the frame is in Orientation A.

[0107] In certain implementations, traction material (e.g., rubber or polymer, possibly texturized) may be added to the cross members to prevent slipping when a user is standing on them. The texturized material may generally be any material that is fairly durable and has increased friction with a shoe sole.

[0108] Side frame members **13** provide part of the base for a frame when in Orientation A and the vertical spine of the frame when in Orientation B. Side frame members **13** also connect the other components in the deadlift linkage assembly. Side frame members **13** have a slight bend in them to establish a pivot point in Orientation A. Cross members **16**, **17** span the subframe, providing lateral support and an area on which a person or persons can stand to provide resistance to the lifter during Orientation A lifts.

[0109] Squat pivots **19** are typically made of hard polymer. They are designed to slightly impale the ground (e.g., dirt, sand, or grass) to serve as a stationary fulcrum when the entire mechanism is lifted from the opposite side (see FIG. **5**).

[0110] Plate posts **15** are typically made of hard polymer and secure weight plates to the mechanism when plates are being used for resistance. The plate posts may also be used by a liftee to stabilize their foot placement.

[0111] Hinges **12**, **18** are typically made of solid aluminum and connect the deadlift linkage assembly to adjacent assemblies. In particular implementations, hinges **12**, **18** could be made of polymers, especially where stress (less thereof) allows.

[0112] Deadlift linkage assembly **10** may also include a load determination assembly **100**, an example of which is illustrated in FIG. **38**. Load determination assembly **100** includes cable **102**, spring **104**, and strain gauges **106**, connected in series using chain links **108**, **110**, **112**. Cable **102** and chain link **112** are secured to a frame member by plates **101**. Plates **101** may be screwed, riveted, welded, or otherwise attached to the frame member. A wire **105** prevents spring **104** from being overstrained.

[0113] Strain gauges **106**, spring **104**, and a portion of cable **102** are located inside a shroud/housing **113** (shown in shadow line here). As the frame member is placed under load, spring **104** may expand, allowing more of cable **102** to be exposed from housing **113**. A section of cable **102** may be marked so that high loads may be visually indicated to a user.

[0114] Electrical wire **114** connects strain gauges **106** to a single instrumentation-driver/battery/transmitter assembly **115**, typically encapsulated in polymer packaging. A wire **116** connects additional strain gauges integrated into the system to the instrumentation-driver/battery/transmitter assembly **115**. The additional strain gauges are not necessary, however, for load determination.

[0115] Load determination assembly **100** as a whole serves to determine felt resistance (by the lifter) by both analog means and digital means (sending gathered data via the transmitter to a paired smart device for further interface with the user). The instrumentation-driver/battery/transmitter assembly **115** can also serve as a centralized power source and controller for additional integrated electronics (e.g., lights, lasers, and speakers) via connection through wire **116**. The controller may, for example, be a microcontroller, a microprocessor, or any other electronic logic device, and the power source may be a battery.

[0116] Additional strain gauges and accelerometers may be placed throughout the mechanism to allow for more refined calculations of applied forces or other strains on the frame.

[0117] FIG. **33** illustrates an example of sled linkage assemblies **20** and dip standing linkage assembly **30**. Sled linkage assemblies **20** connect at one end to deadlift linkage assembly **10**, and dip standing linkage assemblies **30** also connect at one end to the deadlift linkage assembly.

[0118] Dip standing linkage assembly **30** includes side members **31**, **32**, cross member **37**, and connectors **39**. Dip standing linkage assembly **30** is typically made from aluminum tubing that is bent, cut, welded, and affixed together with connectors **39**, which may be aluminum or steel. Side members **31**, **32** and cross member **37** could be made of other suitable materials (e.g., polymers) in other implementations as long as they satisfied the loading requirements, although weight and cost would be additional factors.

[0119] Cross member **37** spans the assembly and provides an area on which a person or persons can stand to provide resistance to the lifter during Orientation A lifts. Traction material may be added to cross member to prevent slipping when a user is standing on it Side members **31**, **32** connect the other components in the dip standing linkage assembly.

[0120] At one end of side members **31** are deadlift pivots **34**. Deadlift pivots **34** are typically made of hard polymer, but could be made of any other relatively hard material. Deadlift pivots **34** are designed to slightly impale the ground (e.g., dirt, grass, or sand) to serve as a stationary fulcrum when the entire frame is lifted from the opposite side (FIG. **6**).

[0121] Connected to cross member **37** (and possibly connectors **39**) are plate posts **38**. Plate posts **38** are typically made of hard polymer and secure weight plates to the mechanism when plates are being used for resistance. Plate posts could also be made of any other relatively hard material. Plate posts **38** may also provide a location for a liftee to stabilize their feet when being lifted.

[0122] Hinges **35**, **33** connect dip standing linkage assembly **30** to adjacent assemblies. Hinges **35**, **33** are typically made of solid aluminum. Hinges **35**, **33** could be made of other suitable materials (e.g., polymers) in other implementations as long as they satisfied the loading requirements, although weight and cost would be additional factors.

[0123] Dip standing linkage assembly **30** also includes wheels **36**. Wheels **36** are typically made of a dense rubber and ball bearings, but any material that is relatively impact resistant may be used. Upon collapse of the frame, the wheels assume an ejected position to allow the user to transport the mechanism via rolling (FIG. **27**).

[0124] Sled linkage assemblies **20** includes sub-frames **22**, which are typically made from aluminum tubing that is cut, bent, welded, and affixed together. Sub-frames **22** could be made of other suitable materials (e.g., polymers) in other implementations as long as they satisfied the loading requirements, although weight and cost would be additional factors. Sub-frames **22** act as sled “skis” when the mechanism is in Orientation C (FIG. **2**).

[0125] At each end of sub-frames **22** are hinges **21**, **25**. These are typically made of solid aluminum and connect the sled linkage assembly to adjacent assemblies. Hinges **21**, **25** could be made of other suitable materials (e.g., polymers) in other implementations as long as they satisfied the loading requirements, although weight and cost would be additional factors.

[0126] Sub-frames **22** also include plate posts **23**. Plate posts **23** are typically made of hard polymer and, in operation, secure weighted plates to the mechanism when plates are being used for resistance (see FIG. **24**). Plate posts could be made of any other relative hard material.

[0127] Sub-frames **22** further include frame guards **24** on their outer surfaces. Frame guards **24** are typically made from a hard polymer, but could be made of any other relatively hard material. Frame guards serve to prevent damage to the frame while it is in Orientation C (see FIG. **2**).

[0128] Connected to each sub-frame **22** is a locking arm **26**. Locking arms **26** serve to hold the frame in the expanded configuration. In particular implementations, locking arms **26** may be homogenous pieces with sub-frames **22**.

[0129] FIG. **34** illustrates an example of squat linkage assembly **50** and sled connector linkage assembly **40**. Squat linkage assembly **50** connects at one end to dip standing linkage assembly **30**, and sled connector linkage assembly **40** connects at one end to sled linkage assemblies **20**.

[0130] Squat linkage assembly **50** includes side frames **51** and a cross member **56**. Side frames **51** and cross member **56** are typically made from aluminum tubing that is bent, cut, welded, and affixed together. Side frames **51** and cross member **56** could be made of other suitable materials (e.g., polymers) in other implementations as long as they satisfied the loading requirements, although weight and cost would be additional factors. Cross member **56** spans the assembly and provides structural support and a potential lift point. Side frames **51** connect the other components in the squat linkage assembly.

[0131] Squat linkage assembly **50** also includes a height-adjustable squat bar assembly **53** composed of a bar **54**, plates **57**, and a pin **58**. Bar **54** is typically made from a textured steel, but could be made of any other relatively hard material as long as it has the necessary strength. Plates **57** are typically made of metal (e.g., steel) and are elongated with holes therein. Side frames **51** include a jog (e.g., an S bend) to accommodate plates **57** so that they do not contact the ground. In some uses cases (e.g., on loose soil), there may, of course, be some contact with the ground, but if the forces carried by the plates are relatively low, this should not cause a problem.

[0132] Bar **54** serves as a lift point during manipulation of the frame. Depending on the height of the lifter, bar **54** can be placed in higher or lower holes in plates **57** to yield the proper rest height. Pin **58** keeps the bar secure at the desired level.

[0133] At each end of side frames **51** are hinges **53**, **55**. Hinges **53**, **55** are typically made of solid aluminum and connect the squat linkage assembly to adjacent assemblies. Hinges **53**, **55** could be made of other suitable materials (e.g., polymers) in other implementations as long as they satisfied the loading requirements, although weight and cost would be additional factors.

[0134] On the exterior of each side frame **51** are frame guards **52**. Frame guards **52** are typically made from a hard polymer, but could be made of any other relatively hard material. Frame guards **52** prevent damage to the frame while it is in Orientation B (see FIG. **2**).

[0135] Sled connector linkage assembly **40** includes side frames **41** and a cross member **44**. Side frames **41** and cross member **44** are typically made from aluminum tubing that is cut and affixed together. Side frames **41** and/or cross member **44** could be made of other suitable materials (e.g., polymers) in other implementations as long as they satisfied the loading requirements, although weight and cost would be additional factors.

[0136] Cross member **44** spans the assembly and provides an area where a person or persons can stand in order to provide resistance in Orientation C exercises. Traction material may be added to cross member to prevent slipping when a user is standing on it. Side frames **41** connect the other components in the sled connector linkage assembly.

[0137] At each end of side frames **41** are hinges **42**, **43**. Hinges **42**, **43** are typically made of solid aluminum and connect the sled connector linkage assembly to adjacent assemblies. Hinges **42**, **43** could be made of other suitable materials (e.g., polymers) in other implementations as long as they satisfied the loading requirements, although weight and cost would be additional factors.

[0138] FIG. **35** illustrates an example of dip sled linkage assemblies **60**. Each dip sled linkage assembly **60** includes members **62**, **63**, **64**. Members **62** are coupled at one end to squat linkage assembly **50**, members **64** are coupled at one end to dip connector assemblies **80**, and each pair of members **62**, **64** are coupled together by a connector **61**. Members **62** serve as sled "skis" when the mechanism is in Orientation C (FIG. **2**). Also coupled to each connector **65** is a member **63**, which is generally orthogonal to adjacent member **62**. Each member **63** is adapted to receive an end of spanning bar assembly **70**.

[0139] Members **62**, **64** are typically made from aluminum tubing that is bent, cut, welded, and affixed together with connectors **65**, which are typically made of solid aluminum. Member **63** is typically made from aluminum tubing that is cut and affixed together to connectors **65**, but may be integrated into connectors **65** as a homogenous piece in certain implementations. Members **62**, **63**, **64** could be made of other suitable materials (e.g., polymers) in other implementations as long as they satisfied the loading requirements, although weight and cost would be additional factors.

[0140] Hinges **66**, **67** are typically made of solid aluminum and connect the dip sled linkage assemblies to adjacent assemblies. Hinges **66**, **67** could be made of other suitable materials (e.g., polymers) in other implementations as long as they satisfied the loading requirements, although weight and cost would be additional factors.

[0141] Each member **62** includes a frame guard **61** on the exterior thereof. Frame guards **61** are typically made from a hard polymer, but could be made of any other relatively hard material. Frame guards **61** prevent damage to the frame and serve as a pivot axis while the mechanism is in Orientation C (see FIG. **2**). Frame guards **61** also prevent damage to the frame while the mechanism is in the Orientation B (see FIG. **3**).

[0142] FIG. **36** illustrates an example spanning hinge bar assembly **70**. As illustrated, spanning hinge bar assembly **70** includes a metal (e.g., steel) bar **71** and spacers **72**, **73**. Spanning hinge bar assembly **70** connects the sled connector linkage assembly and the dip sled linkage assembly while still allowing rotational freedom from one another. Bar **71** provides structural support and a hinge point.

[0143] FIG. **37** illustrates example dip connector assemblies **80**. Each dip connector assembly **80** include a side frame **81** and hinges **82**, **83**. Side frames **81** are typically made from aluminum tubing that is bent and cut to size and serve to limit the degrees of freedom allowed while collapsing (See FIG. **26**). In particular, connecting the dip sled assembly and the deadlift assembly with a link/member yields a one degree of freedom mechanism. Hinges **82**, **83** are typically made of solid aluminum and connect the dip connector linkage assembly to adjacent assemblies. Side frame **81** and hinges **82**, **83** could be made of other suitable materials (e.g., polymers) in other implementations as long as they satisfied the loading requirements, although weight and cost would be additional factors.

[0144] On the inside of each side frame **81** is a female portion of a collapse hinge **85**. Hinge portions **85** are typically made of bent metal (e.g., steel) and receive one of pins **84** to connect the dip connector linkage assembly to sled linkage assembly **20**, resulting in zero degrees of freedom in the frame when expanded. Upon removal of pins **84**, the dip connector linkage assembly and the sled linkage assembly are no longer fixed together, thus, allowing the frame to collapse (see FIG. **26**) with one degree of freedom.

[0145] FIG. **39** illustrates the expanded and collapsed dimensions for system **1** for an example implementation. As illustrated, system **1** is about 90 inches tall and 55 inches deep, in Orientation B, when expanded and about 46 inches tall and 31 inches deep when collapsed. System **1** is about 45 inches wide. Thus, system **1** may be transported in a van or larger SUV when collapsed. In terms of volume, system **1** collapses to less than about one-third of its volume.

[0146] The drawings shown herein are believed to provide fairly accurate representations of the illustrated implementations. Thus, lengths, angles, relative sizes, positioning of parts, orientation of parts, and like information can be readily extracted therefrom by one of skill in the art. However, the invention is not limited to the exact dimensions/sizes shown (e.g., bend radiuses, angles, etc. may need to be adjusted for various implementations).

[0147] A number of implementations have been shown and discussed, and several others have been suggested. Moreover, those of skill in the art will readily recognize that a variety of additions, deletions, substitutions, and transformations may be made while still achieving a multifunction, reorientable, collapsible exercise system. Thus, the scope of protected matter should be judged based on the claims, which may encompass one of more aspects of one of more implementations.

1. An exercise system comprising a frame having a multitude of linked members, the frame configured to be reoriented onto various sides thereof to provide a user with different groups of exercises for each orientation, at least some of a first group of exercises involving the pivoting of the frame about an end.

2. The system of claim **1**, wherein at least one of the first group of exercises involves pivoting the frame about a second end.

3. The system of claim **1**, wherein the frame has three orientations in which exercises may be performed, at least some of a second group of exercises involving sliding of the frame on the ground.

4. The system of claim **3**, wherein the frame is configured to resist sliding on the ground for the first group of exercises and to assist sliding on the ground for at least some of the second group of exercises.

5. The system of claim **3**, wherein the frame has a bottom side, a back side, and a front side, and the orientations of the frame include upright, on its back, and on its front.

6. The system of claim **1**, wherein a second group of exercises involve pivoting the frame about a different end.

7. The system of claim **1**, wherein the frame comprises a base, a vertical section, and a top section when in an upright orientation, the vertical section being hingedly attached to the base and hingedly attached to the top section.

8. The system of claim **7**, wherein the base comprises two portions that are hinged to each other.

9. The system of claim **1**, wherein the frame is configured to support a person such that the person acts as a weight for a number of exercises.

10. The system of claim **7**, wherein the frame is configured to support a person at multiple locations such that the resistance felt by a user is altered.

11. The system of claim **1**, wherein the frame is configured to collapse along a single degree of freedom to less than one-half of its expand volume.

12. The system of claim **10**, wherein the frame is configured to collapse along a single degree of freedom to less than one-third of its expanded volume.

13. The system of claim **1**, wherein the system includes a mechanical overload indicator coupled to the frame.

14. The system of claim **1**, wherein the system includes a mechanical exertion level indicator coupled to the frame.

15. The system of claim **1**, wherein the system includes integrated electronics coupled to the frame to detect strain thereon and a transmitter to wirelessly send the detected strain to a remote computing device.

16. The system of claim **15**, wherein the computing device is configured to receive the strain indications and determine an exertion level for the exercise being performed.

17. The system of claim **16**, wherein the computing device is programmed to provide exercise instructions to a user.

18. The system of claim **1**, wherein the system includes light emitting electronics integrated into the frame to provide instruction and safety features for the exercise being performed.

19. The system of claim **1**, wherein the system includes audio electronics integrated into the frame to provide instruction and safety features for the exercise being performed.

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