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(54) **EXERCISE BICYCLE**

(57) An exercise bicycle comprising a frame including a first portion and a second portion, the first and second portions being pivotally coupled to each other and being adjustable in a plurality of positions, and a support rod including a first end and second end, the first end

pivotaly coupled to the first portion of the frame and the second end pivotally coupled to the second portion of the frame, the support rod configured to adjustably lock the first and second portions in each of the plurality of positions.

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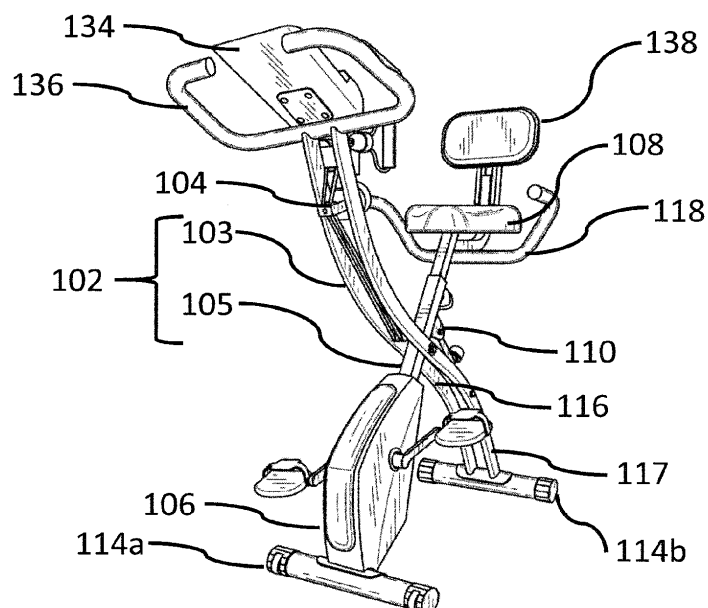


FIG. 1

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Description

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application Serial No. 62/634,791, filed on February 23, 2018, and of U.S. Application Serial No. 16/276,893, filed on February 15, 2019, which are incorporated by reference in their entirety.

FIELD

[0002] Embodiments of the present invention relate generally to an exercise device, and more particularly to a stationary exercise bicycle.

BACKGROUND

[0003] Exercising can be a difficult and undesirable chore. Many existing exercising equipment only allow a user to exercise their upper body or lower body, not both simultaneously. Exercise bicycles allow user to exercise their lower body and cardiovascular system simultaneously, however, many do not allow for simultaneous exercise of the upper body. Moreover, many exercise bicycles are bulky, heavy and/or take up large amount of space. Accordingly, many exercise bicycles cannot be stored easily or compactly in small spaces. For example, many exercise bicycles are too heavy to be maneuvered and can be difficult to be stored, especially in small spaces such as under a bed or in a closet. Further, many exercise bicycles are not configured to allow the user to be in different positions, such as in different recumbent positions, during exercise.

SUMMARY

[0004] Embodiments of the present invention can provide an exercise bicycle. The exercise bicycle can include a frame including a first portion and a second portion and a support rod. The first and second portions can be pivotally coupled to each other and be adjustable in a plurality of positions. The support rod can include a first end and second end, the first end can be pivotally coupled to the first portion of the frame and the second end can be pivotally coupled to the second portion of the frame, and the support rod can be configured to adjustably lock the first and second portions in each of the plurality of positions.

[0005] According to embodiments of the present invention, the exercise bicycle can further include a resistance cord assembly. According to certain exemplary embodiments, the resistance cord assembly can include at least two resistance cords each having a handle. According to embodiments of the present invention, each handle can be configured to adjust the tension of the at least two resistance cords.

[0006] According to certain exemplary embodiments,

the plurality of positions can include a storage position and/or at least one recumbent position.

[0007] According to certain exemplary embodiments, the exercise bicycle can include a pedal assembly. According to certain exemplary embodiments, the pedal assembly can include a flywheel and a magnet.

[0008] According to certain exemplary embodiments, the exercise bicycle can include an adjustable backrest. According to certain exemplary embodiments, the adjustable backrest can include a threaded knob, actuation of which adjusts a recline of adjustable backrest.

[0009] According to certain exemplary embodiments, the exercise bicycle can include a frame including a first portion pivotally coupled to a second portion, a seat coupled to the first portion, a pedal assembly coupled to the first portion, and a resistance cord assembly coupled to the second portion. The resistance cord assembly can include at least two resistance cords, and a handle coupled to each of the at least two resistance cords, each handle being configured to adjust the tension of the at least two resistance cords.

[0010] According to certain exemplary embodiments, the first and second portions can be adjustable in a plurality of positions.

[0011] According to certain exemplary embodiments, the exercise bicycle can include a support rod pivotally coupled to the frame and configured to adjustably lock the first and second portions in the plurality of positions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The features and advantages of the present invention can be more readily understood from the following detailed description with reference to the accompanying drawings, wherein:

FIG. 1 is a front perspective view of an exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 2 is a side view of an exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 3 is a side view of an exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 4 is a side view of an exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 5 is a back perspective view of an exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 6 is a close-up exploded view of a portion of an exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 7 is a close-up exploded view of a portion of an exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 8 is a close-up exploded view of a portion of an

exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 9 is a close-up view of an exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 10 is a close-up view of an exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 11 is a close-up view of an exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 12 is a close-up view of an exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 13 is a close-up view of an exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 14 is a close-up view of an exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 15 is a close-up view of an exemplary exercise bicycle according to an embodiment of the present invention;

FIG. 16 is a close-up view of an exemplary exercise bicycle according to an embodiment of the present invention; and,

FIG. 17 is a close-up view of an exemplary exercise bicycle according to an embodiment of the present invention.

DETAILED DESCRIPTION

[0013] Exemplary embodiments of the present invention can provide a novel exercise bicycle. An embodiment of the present invention can provide exemplary exercise bicycle 100, as shown in FIGS. 1-5. Specifically, certain exemplary embodiments can provide exercise bicycle 100, which can include pedal assembly 160 and resistance cord assembly 104, which can allow a user to exercise their lower body while simultaneously exercising their upper body. As shown in FIGS. 1-2, according to exemplary embodiments, exemplary exercise bicycle 100 can include frame 102, pedal assembly 160 with variable resistance, display 134, seat 108 with adjustable backrest 138, front armrest assembly 136, rear armrest assembly 118, and resistance cord assembly 104. In use, a user may engage pedal assembly 160 to exercise his/her lower body and cardiovascular system, while simultaneously engaging resistance cord assembly 104 to exercise his/her upper body. Additionally, a user may selectively engage resistance cord assembly 104 without engaging pedal moving mechanism 126 in order to only exercise his/her upper body. Similarly, a user may only engage pedal moving mechanism 126 without engaging resistance cord assembly 104 in order to only exercise his/her lower body. Additionally, a user can sit in seat 108 and utilize resistance cord assembly 104 to exercise his/her upper body while simultaneously exercising his/her lower

body via pedal assembly 106. Further, frame 102 can allow exercise bicycle 100 to be adjusted between various positions. For example, the frame may be folded such that it minimizes the amount of space it requires thereby allowing a user to easily store exercise bicycle 100. Additionally, the frame may be adjusted into various a recumbent position to allow a user to exercise in a recumbent position.

[0014] As shown in FIGS. 1-2, frame 102 can include first frame member 103 and second frame member 105, which may be configured in an intersecting orientation to form an "X" configuration. First frame member 103 can include two parallel support rods 116, 117, and support 114a can be coupled to a first end of first frame member 103, and resistance cord assembly 104 and front armrest assembly 136 can be coupled proximate a second end of first frame member 103, which is opposite the first end. Two parallel support rods 116, 117 enable first frame member 103 to be strong yet lightweight such that the overall weight of exercise bicycle 100 remains minimal. Additionally, support 114a can allow exercise bicycle 100 to remain stable and upright. Support 114a may optionally include wheels to allow exercise bicycle 100 to be easily transported. First frame member 103 can be of any shape. For example, first frame member 103 can be linear and straight, or a curved shape as shown in FIGS. 1-5.

[0015] As shown in FIGS. 1-5, support 114b and pedal assembly 106 can be coupled to a first end of frame member 105, and seat 108 can be coupled proximate a second end of frame member 105, which is opposite the first end. According to one exemplary embodiment, second frame member 105 may include telescoping inner tube 105a and outer tube 105b. Inner tube 105a can be concentric to outer tube 105b. Inner tube 105a may be slidably received within outer tube 105b. As a result, inner tube 105a may slide within and relative to outer tube 105b so as to change the length of second frame member 105 in a telescoping action, thereby allowing a user to change the distance between seat 108 and pedal assembly 106 so as to adjust bicycle 100 to, for example, accommodate users of different sizes. Additionally, inner tube 105a and outer tube 105b may be of hollow construction so as to enable second frame member 105 to be strong yet lightweight such that the overall weight of exercise bicycle 100 remains minimal. Cross-sections of inner tube 105a and outer tube 105b may be of any shape, such as square, hexagonal, round, etc. Support 114b can allow exercise bicycle 100 to remain stable and upright when exercise bicycle 100 is placed on a flat surface for use. Support 114b may optionally include wheels to allow exercise bicycle 100 to be easily stowed into storage. Additionally, second frame member 105 may include pedal assembly 106 and rear armrest assembly 118. Second frame member 105 can be of any shape. For example, second frame member 105 can be linear and straight as shown in FIGS. 1-5, or a curved shape.

[0016] As shown in FIGS. 1-5, first frame member 103

may be pivotally coupled to second frame 150. For example, a middle portion of first frame member 103 may be coupled to a middle portion of second frame member 105, forming an "X" shape. As such, first 103 can be coupled to second frame member 105 via a pivoting hinge. Pivoting hinge may be of any type, for example, a cabinet door hinge, corner hinge, knife-type hinge, etc. In operation, pivoting hinge enables first frame member 103 to pivot relative to second frame member 105.

[0017] Additionally, bicycle 100 can include frame support rod 110, which can be disposed between first frame member 103 and second frame member 105 and may be adjustable in length to facilitate pivoting of first frame member 103 relative to second frame member 105. Support rod 110 may include telescoping outer tube 120 and inner tube 122, and locking screw 124. Inner tube 122 may be telescopically disposed within outer tube 120, and an upper end of outer tube 120 (i.e., a first end of support rod 110) may be pivotally coupled to first frame member 103. A lower end of inner tube 122 (i.e., a second end of support rod 110) may be pivotally coupled to first frame member 103. Inner tube 122 may include a plurality of threaded holes. Outer tube 120 can include locking screw 124 which passes through outer tube 120 and optionally engages with the threaded holes on inner tube 122 allowing inner tube 122 and outer tube 120 to be locked in different positions. As shown in FIGS. 11-13, locking screw 124 may be a threaded knob with a spring-loaded plunger. According to alternative embodiments, locking screw 124 may be manual lever, an electronic adjustment mechanism, or any other alternative mechanism. Threaded knob may be loosened via rotation of the threaded knob, and the threaded knob may be pulled in an outward direction to disengage the spring-loaded plunger. According to alternative embodiments, the threaded knob may also be loosened without rotation and only by pulling in an outward direction. When the spring-loaded plunger is disengaged, the position of inner tube 122 may be adjusted relative to outer tube 120 in a telescopic action. The spring-loaded plunger may be configured to engage the threaded holes to keep exemplary exercise bicycle 100 secured in a specific position, e.g., in practice, a user may adjust locking screw 124 to pass through a specific threaded hole, altering the degree of angle between first frame member 103 and second frame member 105. For example, inner tube 122 may be telescopically adjusted relative to outer tube 120, and inner tube 122 and outer tube 120 can be locked in a plurality of positions so that the length of support rod 110 can be changed. The various lengths of support rod 110 enable a user to adjust the angle at which first frame member 103 is pivotally coupled to second frame member 105. For example, as shown in FIG. 3, inner tube 122 and outer tube 120 can be locked in a first position wherein the length of support rod 110 is the shortest allowing exercise bicycle to be in a storage position. In the storage position, exercise bicycle 100 has a minimal footprint, which may be beneficial in allowing a user to conveniently

and compactly store exercise bicycle 100 in small spaces. Additionally, as shown in FIG. 4, inner tube 122 and outer tube 120 can be locked in a second position wherein the length of support rod 110 is the longest allowing exercise bicycle to be in a recumbent position. Further, inner tube 122 and outer tube 120 can be locked in a plurality of recumbent positions between the first, storage position and the second, recumbent position. Various recumbent positions may be beneficial in allowing user with extremities of different lengths to comfortably position themselves on exercise bicycle 100 during use. In operation, a user may disengage locking screw 124 thereby enable inner tube 122 to slide within outer tube 120 and re-engage locking screw 124 with a different threaded hole on inner tube 122, thereby changing the length of support rod 110. Since support rod 110 is pivotally coupled to first frame member 103 and second frame member 105, changing the length of support rod 110 causes first frame member 103 and second frame member 105 to pivot relative to each other, thereby changing the position of exercise bicycle 100.

[0018] As shown in FIGS. 1, 2, 9, and 10, pedal assembly 106 may include pedal moving mechanism 126 and damping knob 129. Pedal moving mechanism 126 may include pedals 128 coupled to metallic flywheel 130 and magnet 132. Movement of pedal 128 may cause rotation of flywheel 130. Magnet 132 can exert a magnetic force on and flywheel 130, which can result in a braking effect on flywheel 130 so that a user can adjust the pedaling resistance. For example, the distance between magnet 132 and flywheel 130 may be directly proportional to the magnetic force exerted by magnet 132 on flywheel 130. Accordingly, the closer magnet 132 is to flywheel 130, the greater the braking effect on flywheel 130. As a result, greater rotational force is required to rotate flywheel 130 and greater force is required to rotate pedals 128. Conversely, the further magnet 132 is from flywheel 130, the lesser the force needed to rotate pedals 128, since there is less of a braking effect on flywheel 130. Damping knob 129 may be disposed on front frame member 103 and may be operatively coupled to pedal moving mechanism 126 via a cable. Damping knob 129 may be configured to adjust the distance between magnet 132 and flywheel 130. As such, damping knob 129 may be configured to adjust the resistance of flywheel 130 of pedal moving mechanism 126, thereby allowing a user to adjust the amount of force needed to move pedals 128. In operation, to exercise their lower body, a user may pedal pedals 128 to rotate flywheel 130, and use damping knob 129 to change the distance between magnet 132 and flywheel 130 thereby changing the pedaling resistance.

[0019] As shown in FIGS. 1-5, seat 108 of exemplary exercise bicycle 100 may be coupled to inner tube 105a of rear frame member 105. Seat 108 can include rear armrest assembly 118, which can be coupled to inner tube 105a and can be disposed around seat 108, and can allow a user to grip rear armrest assembly 118 while

being seated on exercise bicycle 100 for added stability. Seat 108 can be adjustable to accommodate users of various heights. For example, a user may slidably adjust inner tube 105a within outer tube 105b to change the overall effective length of rear frame member 105, and thereby changing the distance between seat 108 and pedal assembly 106. This may be beneficial, for example, to allow users with long legs to comfortably position themselves on seat 108 relative to pedal assembly 106. Seat 108 can also include backrest 138 which can be pivotally coupled to seat 108. As shown in FIGS. 2 and 17, the angle of backrest 138 relative to seat 108 may be configured to be adjustable via threaded knob 140. For example, clockwise rotation of threaded knob 140 can cause threaded knob 140 to be pushed against a support, which may cause the angular tilt of backrest 140 relative to seat 108 to increase or decrease (i.e., enable a user to change the recline of backrest). As such, backrest 140 may be adjusted to the liking and comfort of a user. In operation, a user may comfortably situate themselves on bicycle 100 by adjusting the distance between seat 108 and pedal assembly 106 to correspond to the length of their legs and/or adjusting backrest 140 to adjust the recline of backrest 140.

[0020] As shown in FIGS. 1-5, display 134 may be coupled to the top of front frame member 103 and front armrest assembly 136. Display 134 may be operatively coupled to pedal moving mechanism 126 and may be configured to determine, for example, number of rotations of flywheel 130. As such, a user may be able to determine, for example, the distance traveled by the user while using exemplary exercise bicycle 100. Additionally, front armrest assembly 136 may include heartrate sensors to detect, for example, the pulse of user, which may be coupled to display 134. In practice, a user may grip the heartrate sensors of front armrest assembly 136 during use, and the heartrate sensors may measure and display the heartrate of user on display 134.

[0021] According to an embodiment of the present disclosure, front frame member 103 may include resistance cord assembly 104. As shown in FIG. 1, resistance cord assembly 104 may be disposed on front frame member 103 of bicycle frame member 105 opposite seat 108. As shown in FIGS. 1, 2, and 6-8, Resistance cord assembly 104 may include first set of guide wheels 140, second set of guide wheels 142, third set of guide wheels 144, and resistance cords 146. Resistance cords 146 may include first end 147, second end 149, and handles 150, and may be made of any elastic material. According to an embodiment, resistance cords 146 may pass through first set of guide wheels 140, second set of guide wheels 142, and third set of guide wheels 142. For example, first set of guide wheels 140 may be coupled to an upper side of front frame member 103 of bicycle frame member 105 via a first set of U-shaped frames, which may be pivotally coupled to front frame member 103. Second set of guide wheels 142 may be disposed on front frame member 103 between first set of guide wheels 140 and third set of

guide wheels 144. Second set of guide wheels 142 may be positioned lower than first set of guide wheels 140 and may be coupled to front frame member 103 via a pin and bracket assembly. Third set of guide wheels 144 may be disposed between two parallel support rods 116, 117 of front frame member 103, on the mid-lower side of front frame member 103. First end 147 of the resistance cords 146 may each include handle 152 which may be configured to allow a user to hold and pull each of resistance cords 146. Although the drawings show first end 147 of resistance cords 146 including handles 152, first end 147 may not include a handle, or may include knob, a rod, or any other element that allows a user to hold and pull the resistance cords. Second end 149 of resistance cords 146 may be coupled to front frame member 103 of bicycle frame 102. According to an embodiment, resistance cords 146 may be configured to engage first set of guide wheels 140, second set of guide wheels 142, and third set of guide wheels 144, between first end 147 and second end 149 of resistance cords 146. In operation, when a user pulls handles 150 away from exercise bicycle 100, resistance cords 146 are elongated, which thereby causes an increase in tension along the length of resistance cord 146. Accordingly, a user may exercise their upper body by repeatedly pulling and releasing resistance cords 146 using handles 150. For example, a user may pull resistance cords 146 to perform a variety of exercises, such as, reverse rows, alternating rows, one-arm rows, low rows, seated curls, kickbacks, lateral raises, woodchops, front raises, flies, etc.

[0022] Further, as shown in FIGS. 2 and 14-16, handle 152 of resistance cords 146 may be configured to allow for the tension of resistance cords 146 to be adjusted by the user, thereby allowing a user to change the intensity of the upper body workout. For example, handle 152 may include retaining member 154 which may be configured to adjust the length of resistance cords 146 between retaining member 154 and second end 149 of resistance cords 146, thereby changing the tension of the resistance cords. Resistance cord 146 may be threaded through retaining member 154, thereby decreasing the length of resistance cord 146 between retaining member 154 and second end 149. As a result, the length of resistance cord 146 as measured between handle 152 and second end 149 decreases. Alternatively, a user may increase the length of resistance cord 146. Changing the length of resistance cord 146 changes the elastic tension and thereby changes the resistance of resistance cords 146. This allows a user to adjust the length of resistance cords 146, thereby adjusting the tension and resistance of the resistance cords.

[0023] The embodiments and examples shown above are illustrative, and many variations can be introduced to them without departing from the spirit of the disclosure. For example, elements and/or features of different illustrative and exemplary embodiments herein may be combined with each other and/or substituted with each other within the scope of the disclosure. For a better under-

standing of the disclosure, reference should be had to any accompanying drawings and descriptive matter in which there is illustrated exemplary embodiments of the present invention.

Aspects of the invention are described in the following clauses:

[0024]

1. An exercise bicycle comprising:

a frame including a first portion and a second portion, the first and second portions being pivotally coupled to each other and being adjustable in a plurality of positions; and a support rod including a first end and second end, the first end pivotally coupled to the first portion of the frame and the second end pivotally coupled to the second portion of the frame, the support rod configured to adjustably lock the first and second portions in each of the plurality of positions.

2. The exercise bicycle of clause 1, further comprising a resistance cord assembly.

3. The exercise bicycle of clause 2, wherein the resistance cord assembly includes at least two resistance cords each having a handle.

4. The exercise bicycle of clause 3, wherein each handle is configured to adjust the tension of the at least two resistance cords.

5. The exercise bicycle of clause 1, wherein the plurality of positions includes a storage position.

6. The exercise bicycle of clause 1, wherein the plurality of positions includes at least one recumbent position.

7. The exercise bicycle of clause 1, further comprising a pedal assembly.

8. The exercise bicycle of clause 7, wherein the pedal assembly includes a flywheel and a magnet.

9. The exercise bicycle of clause 1, further comprising an adjustable backrest.

10. The exercise bicycle of clause 9, wherein the adjustable backrest includes a threaded knob, actuation of which adjusts a recline of adjustable backrest.

11. An exercise bicycle comprising:

a frame including a first portion pivotally coupled to a second portion;
a seat coupled to the first portion;
a pedal assembly coupled to the first portion;
and
a resistance cord assembly coupled to the second portion, the resistance cord assembly including

at least two resistance cords,
a handle coupled to each of the at least two resistance cords, each handle being configured to adjust the tension of the at least two resistance cords.

12. The exercise bicycle of clause 11, wherein the first and second portions are adjustable in a plurality of positions.

13. The exercise bicycle of clause 11, further comprising an adjustable backrest.

14. The exercise bicycle of clause 13, wherein the adjustable backrest includes a threaded knob, actuation of which adjusts a recline of adjustable backrest.

15. The exercise bicycle of clause 12, further comprising a support rod pivotally coupled to the frame and configured to adjustably lock the first and second portions in the plurality of positions.

16. The exercise bicycle of clause 15, wherein the plurality of positions includes a storage position.

17. The exercise bicycle of clause 15, wherein the plurality of positions includes at least one recumbent position.

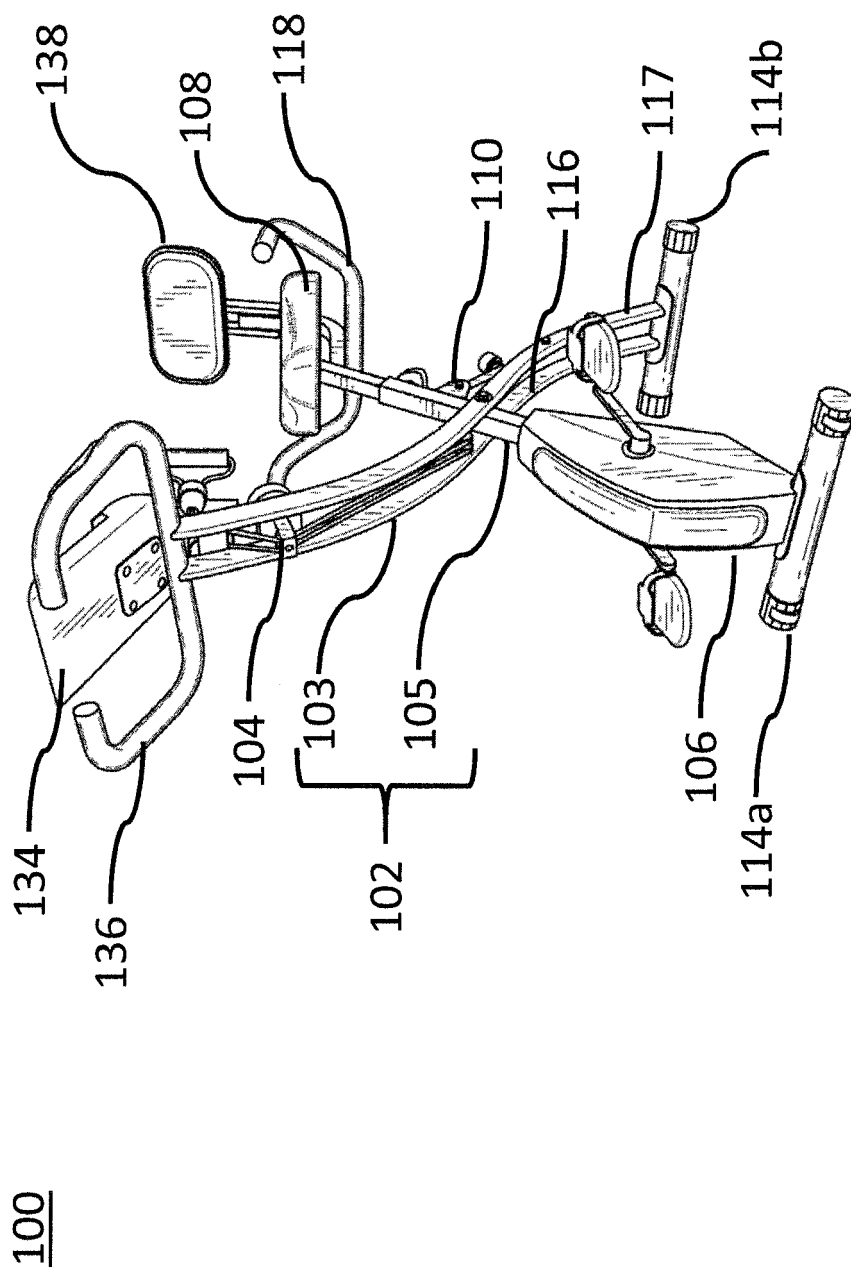
Claims

1. An exercise bicycle comprising:

a frame including a first portion and a second portion, the first and second portions being pivotally coupled to each other and being adjustable in a plurality of positions; and a support rod including a first end and second end, the first end pivotally coupled to the first portion of the frame and the second end pivotally coupled to the second portion of the frame, the support rod configured to adjustably lock the first and second portions in each of the plurality of positions.

2. The exercise bicycle of claim 1, further comprising a resistance cord assembly.

3. The exercise bicycle of claim 2, wherein the resistance cord assembly includes at least two resistance cords each having a handle.
4. The exercise bicycle of claim 3, wherein each handle is configured to adjust the tension of the at least two resistance cords. 5
5. The exercise bicycle of any one of the preceding claims, wherein the plurality of positions includes a storage position. 10
6. The exercise bicycle of any one of the preceding claims, wherein the plurality of positions includes at least one recumbent position. 15
7. The exercise bicycle of any one of the preceding claims, further comprising a pedal assembly.
8. The exercise bicycle of claim 7, wherein the pedal assembly includes a flywheel and a magnet. 20
9. The exercise bicycle of any one of the preceding claims, further comprising an adjustable backrest. 25
10. The exercise bicycle of claim 9, wherein the adjustable backrest includes a threaded knob, actuation of which adjusts a recline of adjustable backrest.
11. An exercise bicycle, in particular of any one of the preceding claims, the exercise bicycle comprising: 30
 - a frame including a first portion pivotally coupled to a second portion;
 - a seat coupled to the first portion; 35
 - a pedal assembly coupled to the first portion; and
 - a resistance cord assembly coupled to the second portion, the resistance cord assembly including 40
 - at least two resistance cords,
 - a handle coupled to each of the at least two resistance cords, each handle being configured to adjust the tension of the at least two resistance cords. 45
12. The exercise bicycle of claim 11, wherein the first and second portions are adjustable in a plurality of positions. 50
13. The exercise bicycle of any one of the claims 11 or 12, further comprising an adjustable backrest.
14. The exercise bicycle of claim 13, wherein the adjustable backrest includes a threaded knob, actuation of which adjusts a recline of adjustable backrest. 55
15. The exercise bicycle of claim 12, further comprising a support rod pivotally coupled to the frame and configured to adjustably lock the first and second portions in the plurality of positions.
16. The exercise bicycle of claim 15, wherein the plurality of positions includes a storage position.
17. The exercise bicycle of any one of the claims 15 or 16, wherein the plurality of positions includes at least one recumbent position.



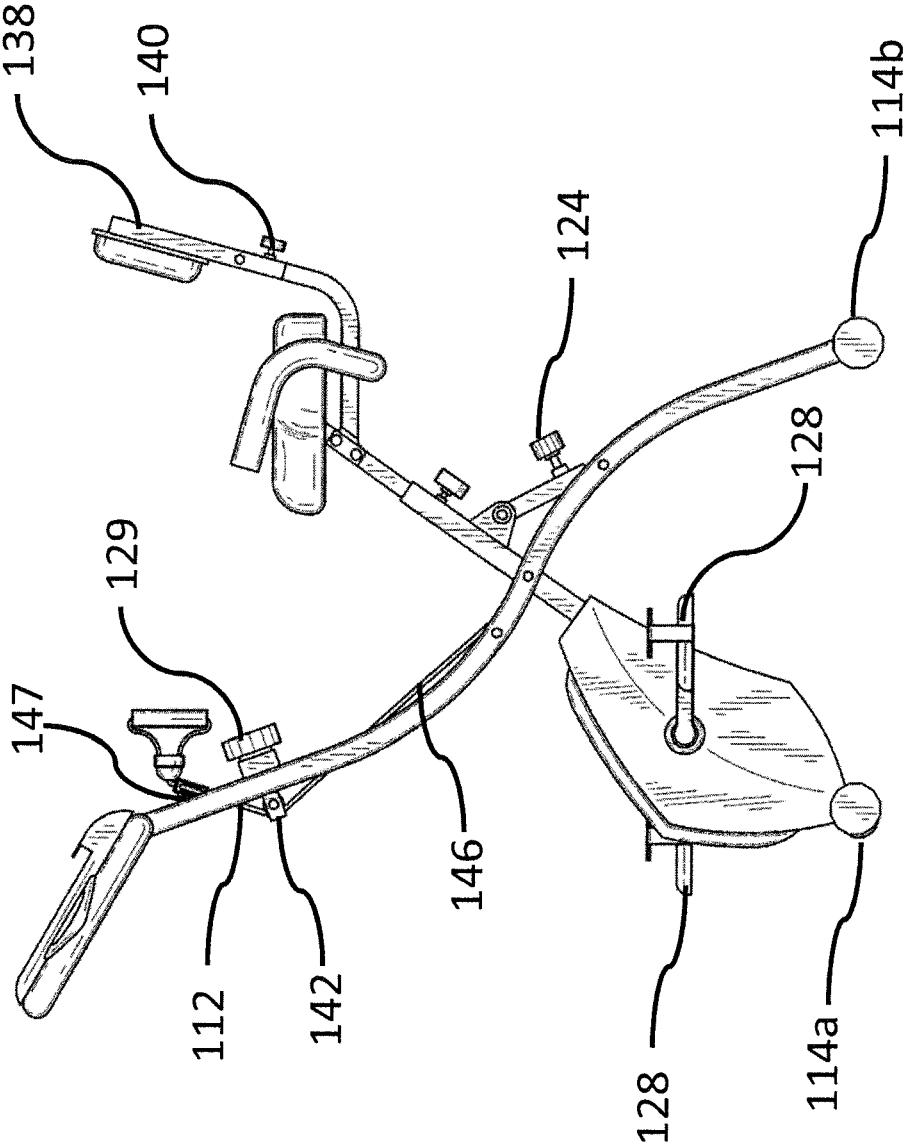


FIG. 2

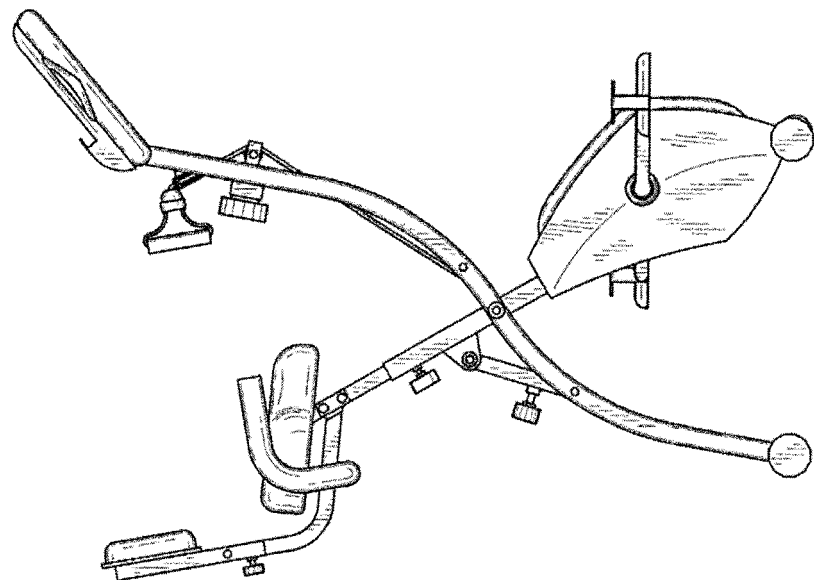


FIG. 3

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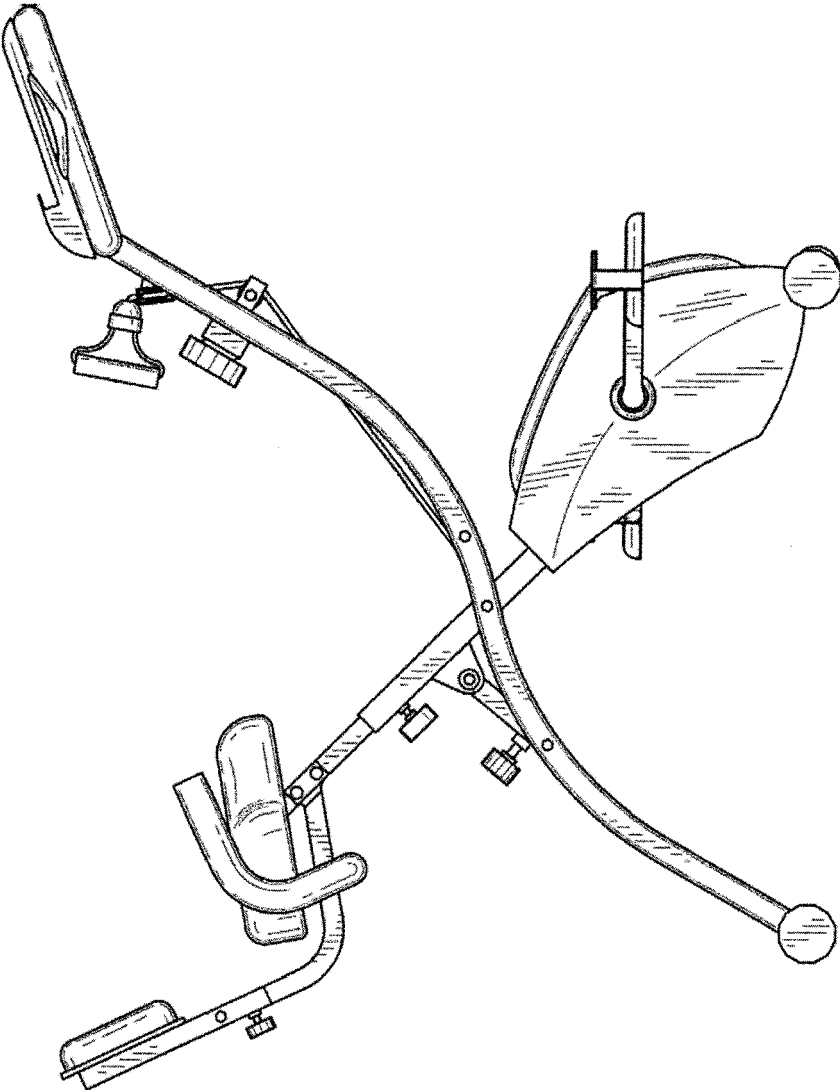


FIG. 4

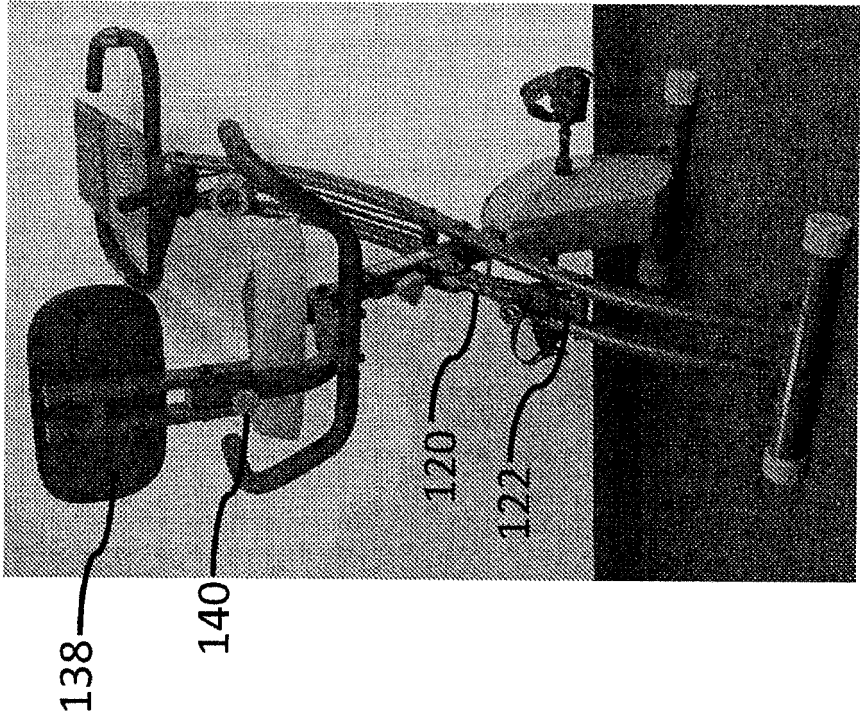


FIG. 5

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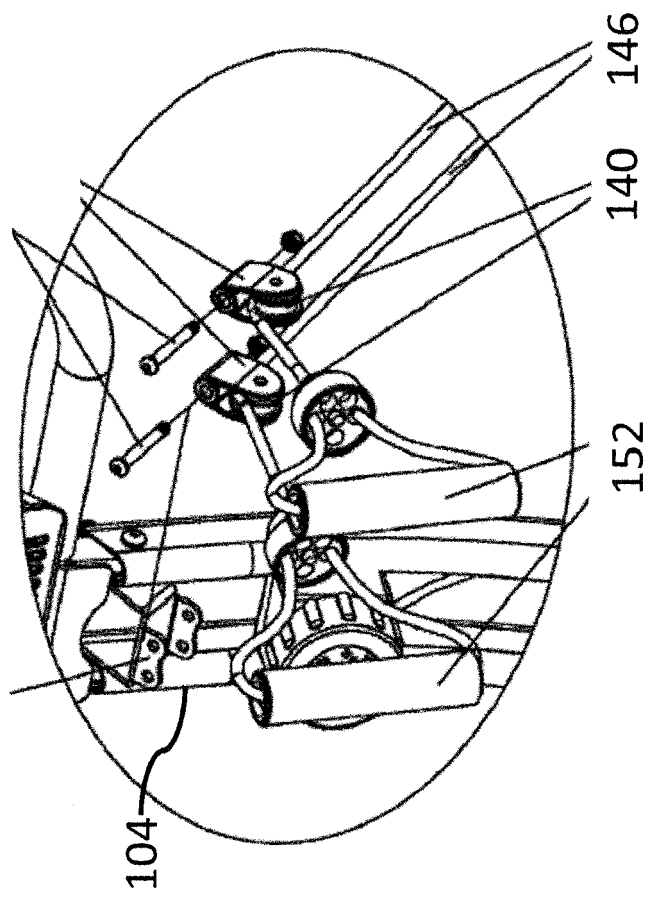


FIG. 6

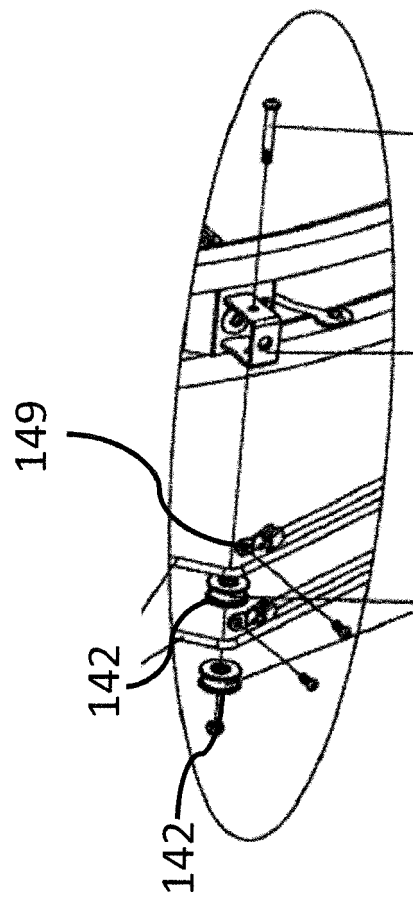


FIG. 7

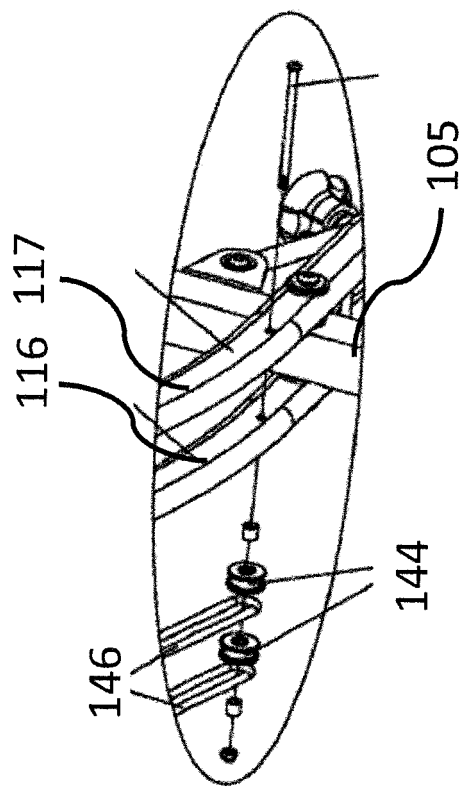


FIG. 8

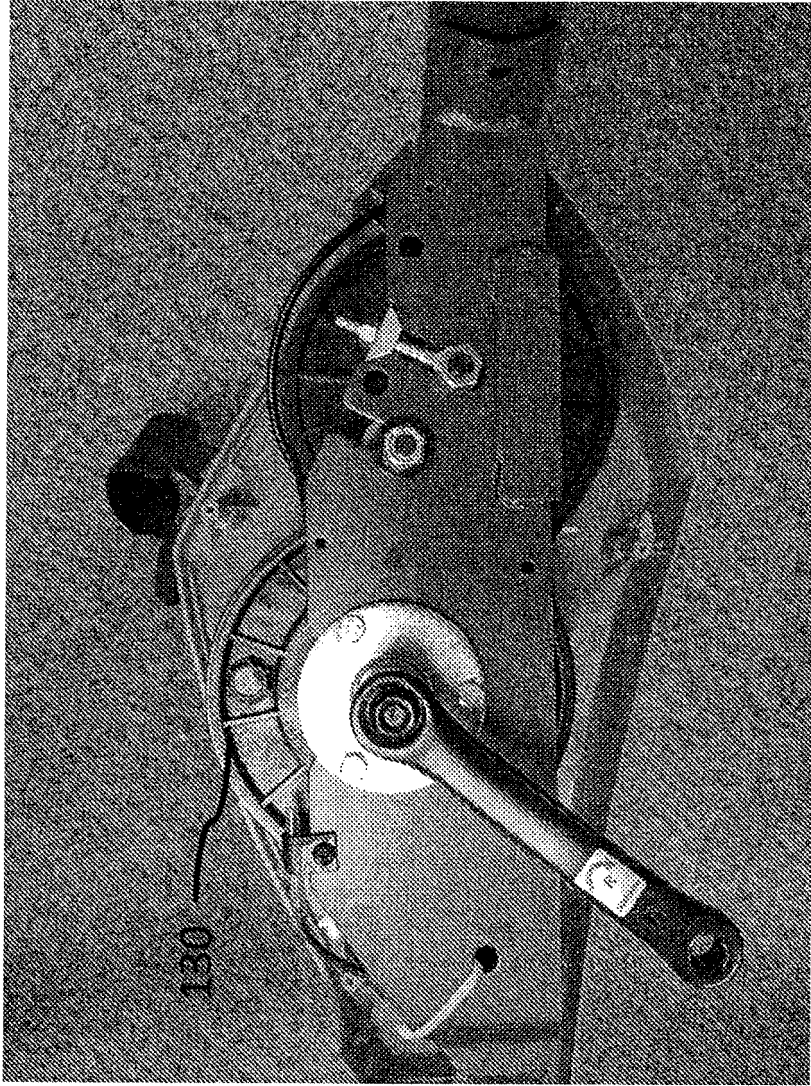


FIG. 9

126

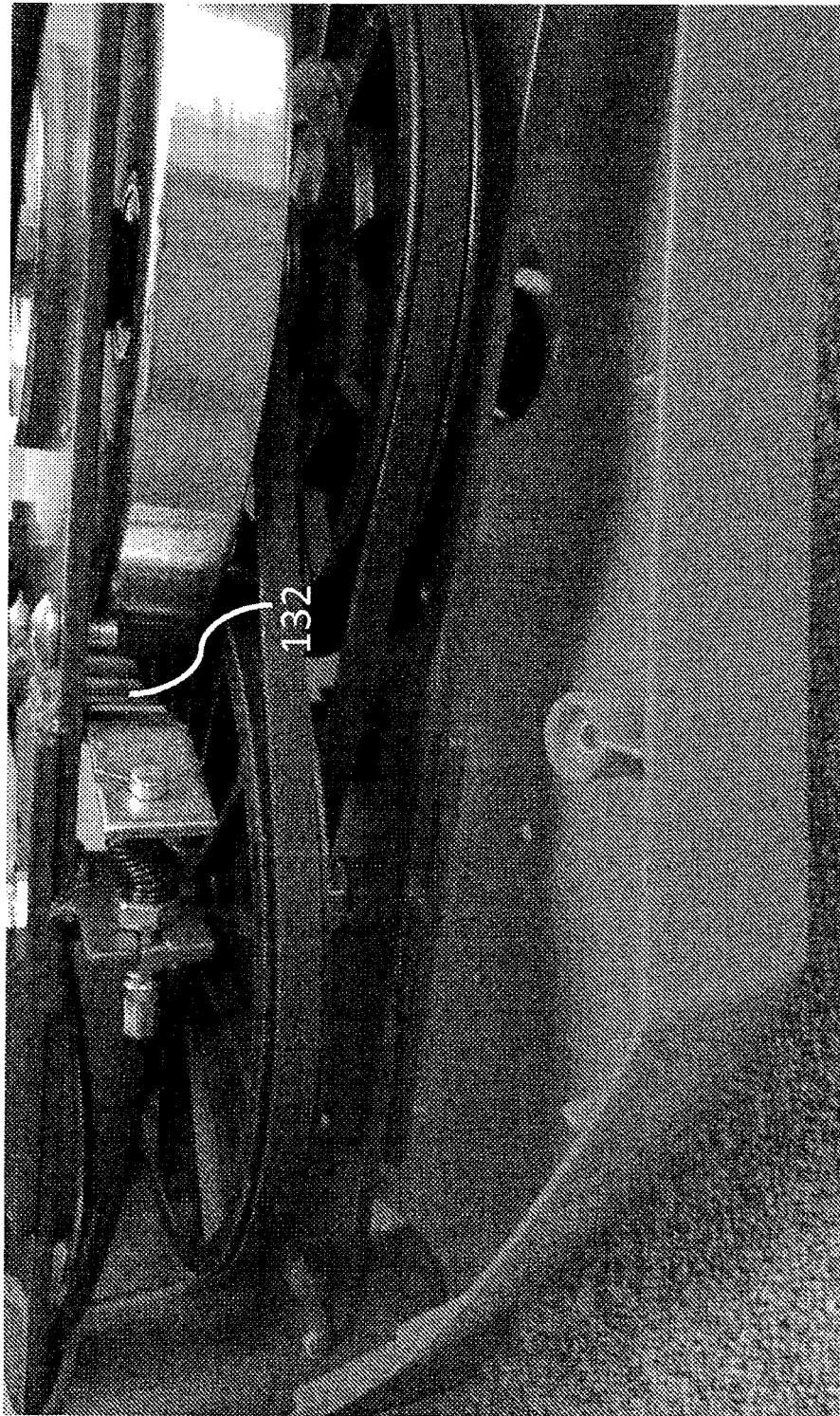


FIG. 10

126

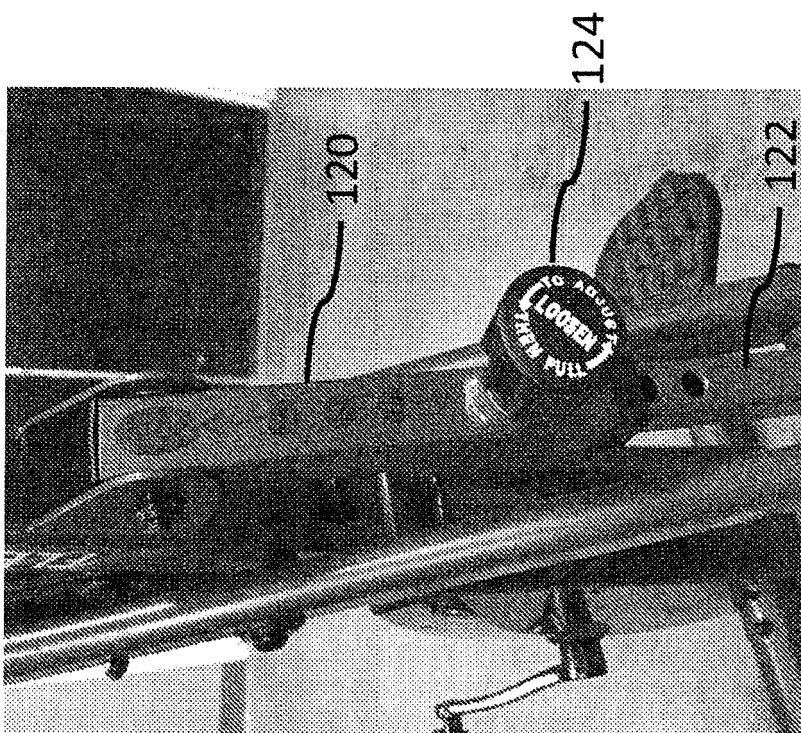


FIG. 11

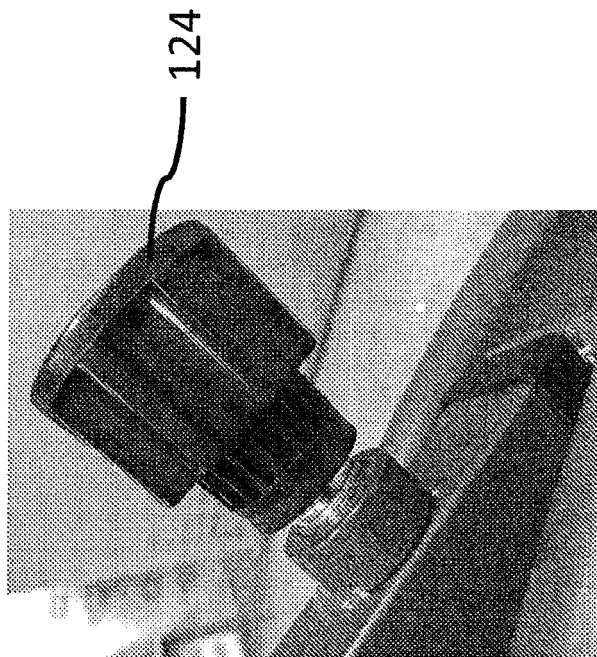


FIG. 12

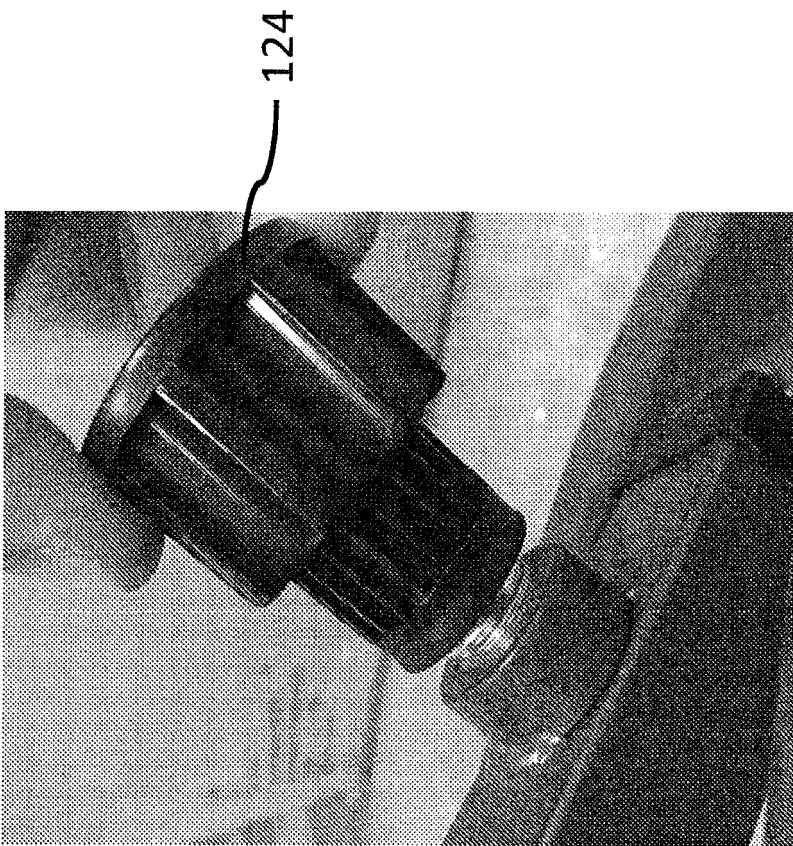


FIG. 13

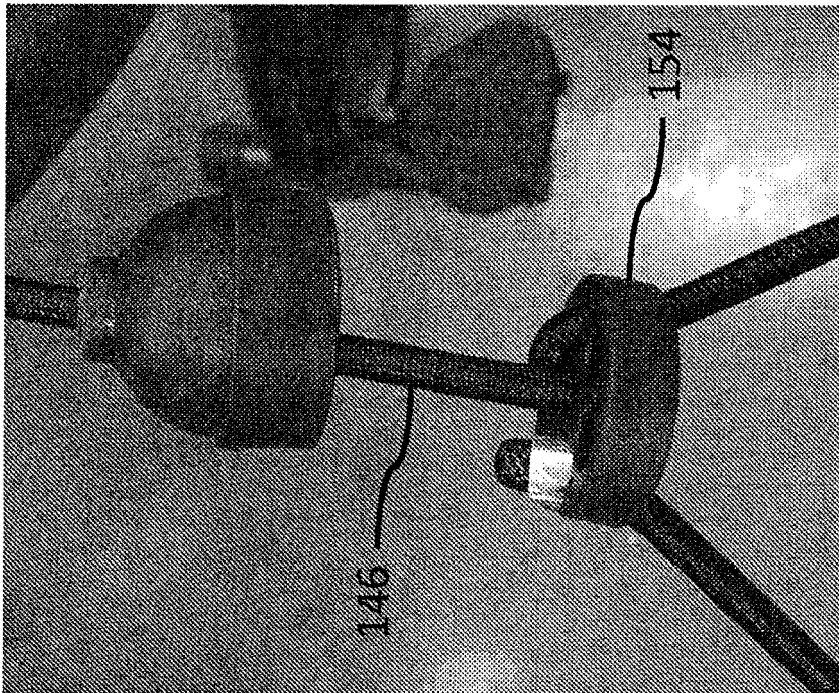


FIG. 14

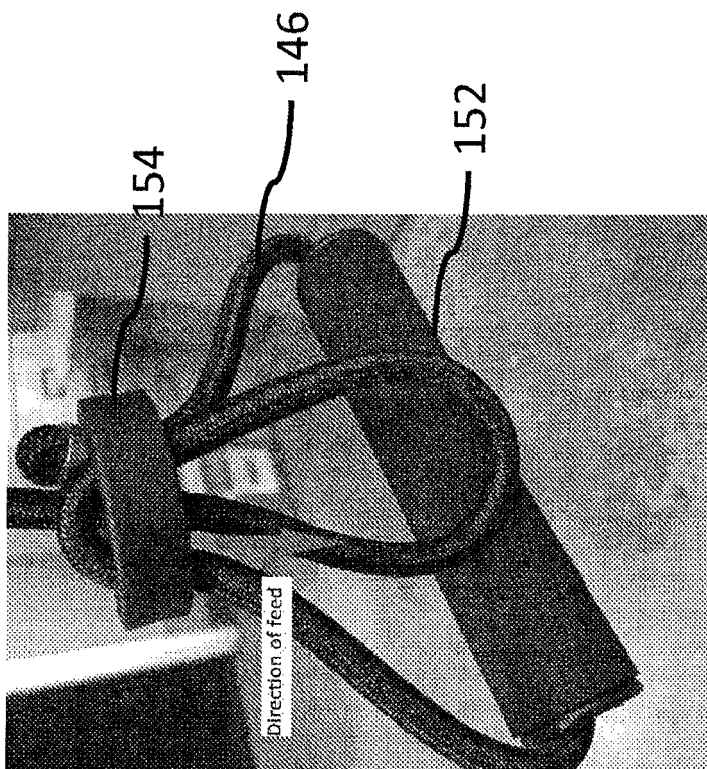


FIG. 15

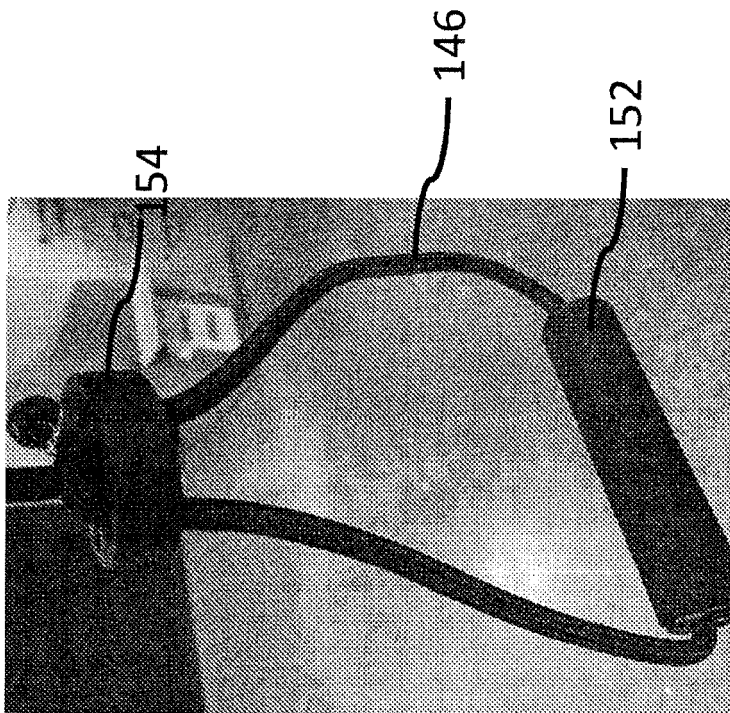


FIG. 16

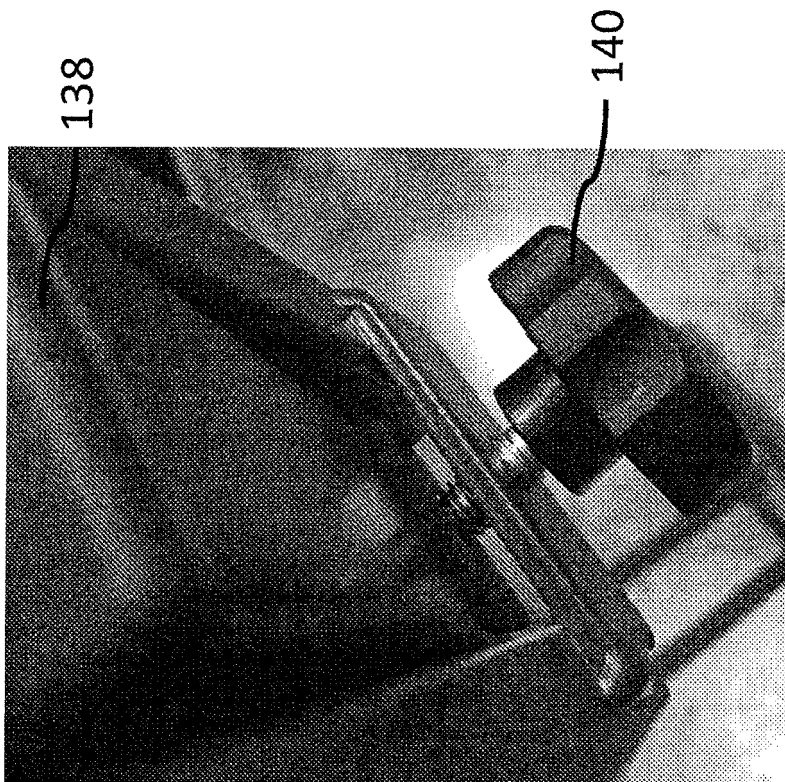


FIG. 17

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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