

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
23 September 2010 (23.09.2010)

(10) International Publication Number
WO 2010/107632 A1

(51) International Patent Classification:
A63B 22/02 (2006.01)

(21) International Application Number:
PCT/US2010/026731

(22) International Filing Date:
9 March 2010 (09.03.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/161,027 17 March 2009 (17.03.2009) US

(71) Applicant (for all designated States except US): **WOODWAY USA, INC.** [US/US]; W229 N591 Foster Court, Waukesha, Wisconsin 53186 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **BAYERLEIN, Douglas, G.** [US/US]; 34675 Bartlett Road, Oconomowoc, Wisconsin 53066 (US). **EMONS, Vance, E.** [US/US]; N79 W28251 Tourmaline Court, Hartland, Wisconsin 53029 (US). **OBLAMSKI, Nicholas, A.** [US/US]; W271 N525 Jills Drive, Waukesha, Wisconsin 53188 (US).

(74) Agents: **McKENNA, Richard** et al.; FOLEY & LARDNER LLP, 777 E. Wisconsin Avenue, Milwaukee, Wisconsin 53202 (US).

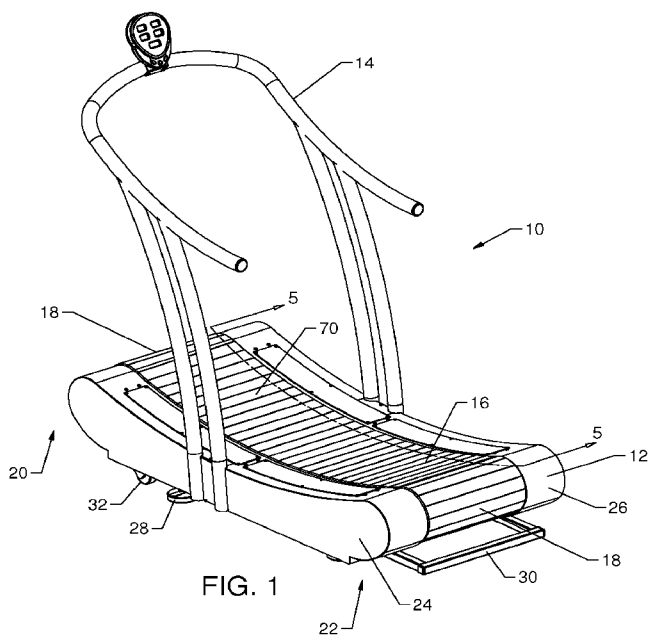
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: POWER GENERATING MANUALLY OPERATED TREADMILL



(57) Abstract: The present invention relates to a manually operated treadmill adapted to generate electrical power comprising a treadmill frame, a running belt supported upon the treadmill frame and adapted for manual rotation, and an electrical power generator mechanically interconnected to the running belt and adapted to convert the manual rotational motion of the running belt into electrical power.

WO 2010/107632 A1

POWER GENERATING MANUALLY OPERATED TREADMILL

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

[0001] This application claims priority from U.S. Provisional Application Serial No. 61/161,027, filed March 17, 2009, which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] The present invention relates generally to the field of treadmills. More specifically, the present invention relates to manual treadmills. Treadmills enable a person to walk, jog, or run for a relatively long distance in a limited space. It should be noted that throughout this document, the term “run” and variations thereof (e.g., running, etc.) in any context is intended to include all substantially linear locomotion by a person. Examples of this linear locomotion include, but is not limited to, jogging, walking, skipping, scampering, sprinting, dashing, hopping, galloping, etc.

[0003] A person running generates force to propel themselves in a desired direction. To simplify this discussion, the desired direction will be designated as the forward direction. As the person's feet contact the ground (or other surface), their muscles contract and extend to apply a force to the ground that is directed generally rearward (i.e., has a vector direction substantially opposite the direction they desire to move). Keeping with Newton's third law of motion, the ground resists this rearwardly directed force from the person, resulting in the person moving forward relative to the ground at a speed related to the force they are creating.

[0004] To counteract the force created by the treadmill user so that the user stays in a relatively static fore and aft position on the treadmill, most treadmills utilize a belt that is driven by a motor. The motor operatively applies a rotational force to the belt, causing that portion of the belt on which the user is standing to move generally rearward. This force must be sufficient to overcome all sources of friction, such as the friction between the belt and other treadmill components in contact therewith and kinetic friction, to ultimately rotate the belt at a desired speed. The desired net effect is that, when the user is positioned on a

running surface of the belt, the forwardly directed velocity achieved by the user is substantially negated or balanced by the rearwardly directed velocity of the belt. Stated differently, the belt moves at substantially the same speed as the user, but in the opposite direction. In this way, the user remains at substantially the same relative position along the treadmill while running. It should be noted that the belts of conventional, motor-driven treadmills must overcome multiple, significant sources of friction because of the presence of the motor and configurations of the treadmills themselves.

[0005] Similar to a treadmill powered by a motor, a manual treadmill must also incorporate some system or means to absorb or counteract the forward velocity generated by a user so that the user may generally maintain a substantially static position on the running surface of the treadmill. The counteracting force driving the belt of a manual treadmill is desirably sufficient to move the belt at substantially the same speed as the user so that the user stays in roughly the same static position on the running surface. Unlike motor-driven treadmills, however, this force is not generated by a motor.

[0006] For most treadmill applications, it is desirable to integrate electrical components which provide feed back and data performance analysis such as speed, time, distance, calories burned, heart rate, etc. However, a manually operated treadmill which does not integrate a motor to drive the running belt may not incorporate a connection to a conventional electrical power source. Alternatively, it may be desirable to use the manually operated treadmill a relatively long distance from a conventional power source. For a whole host of environmental and practical reasons, there may be some benefit to creating a treadmill which is manually operated, but integrates a power generator to provide the necessary electrical power for operation of the treadmill or alternatively to generate power for the operation of other electrically powered products.

SUMMARY

[0007] One embodiment of the invention relates to a manually operated treadmill adapted to generate electrical power comprising a treadmill frame, a running belt supported upon the treadmill frame and adapted for manual rotation, and an electrical power generator mechanically interconnected to the running belt and adapted to convert the manual rotational motion of the running belt into electrical power.

[0008] Another embodiment of the invention relates to a treadmill comprising a treadmill frame; a support member rotationally supported upon the treadmill frame; a running belt supported by and interconnected to the support member, the running belt being mounted solely for manual rotation about the support member; an electrical power generator adapted to convert rotational movement into electrical power; and a power transfer belt mounted to interconnect the electrical power generator to the support member so that the rotational movement of the support member is transferred to the electrical power generator which in turn creates electrical power.

[0009] Another embodiment of the invention relates to a method of providing power to a treadmill comprising the steps of providing a treadmill frame, a support member rotationally supported upon the treadmill frame, a running belt supported by and interconnected to the support member, the running belt being mounted solely for manual rotation about the support member, an electrical power generator supported on the treadmill frame being adapted to convert rotational movement into electrical power, a power transfer belt adapted to interconnect the electrical power generator and the support member so that the rotational movement of the support member is transferred to the electrical power generator which in turn creates electrical power; and an electrical display panel being adapted to calculate and display performance data relating to operation of the treadmill. The invention further comprises the step of electrically interconnecting the electrical power generator to a display panel so that the electrical power necessary to operate the electrical display panel is supplied by the power generator.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 is a perspective view of an exemplary embodiment of a manual treadmill having a non-planar running surface.

[0011] FIG. 2 is a left-hand partially exploded perspective view of a portion of the manual treadmill according to the exemplary embodiment shown in FIG. 1.

[0012] FIG. 3 is a right-hand partially exploded perspective view of a portion of the manual treadmill according to the exemplary embodiment shown in FIG. 1.

[0013] FIG. 4 is a partial side elevational view of the manual treadmill of FIG. 1 with a portion of the treadmill cut-away to show a portion of the arrangement of elements.

[0014] FIG. 5 is a cross-sectional view of a portion of the manual treadmill taken along line 5-5 of FIG. 1.

[0015] FIG. 6 is an exploded view of a portion of the manual treadmill of FIG. 1 having the side panels and handrail removed.

[0016] FIG. 7 is a left-hand partially exploded perspective view of a portion of the manual treadmill according to the exemplary embodiment shown in FIG. 1 including a power generation system.

[0017] FIG. 8 is partially exploded view of a portion of the manual treadmill according to the exemplary embodiment shown in FIG. 7.

[0018] FIG. 9 is perspective view of the manual treadmill according to the exemplary embodiment shown in FIG. 7.

[0019] FIG. 10 is a electrical system diagram of the power generation system according to an electrical embodiment.

[0020] FIG. 11 is a left-hand partially exploded perspective view of a portion of the manual treadmill according to the exemplary embodiment shown in FIG. 1 including a power generation system and a drive motor.

[0021] FIG. 12 is a left-hand partially exploded perspective view of a portion of the manual treadmill according to the exemplary embodiment shown in FIG. 1 including a drive motor.

[0022] FIG. 13 is a left-hand partially exploded perspective view of a portion of the manual treadmill according to the exemplary embodiment shown in FIG. 1 a motorized elevation adjustment system.

DETAILED DESCRIPTION

[0023] Referring to FIG. 1, a manual treadmill 10 generally comprises a base 12 and a handrail 14 mounted to the base 12 as shown according to an exemplary embodiment. The base 12 includes a running belt 16 that extends substantially longitudinally along a longitudinal axis 18. The longitudinal axis 18 extends generally between a front end 20 and

a rear end 22 of the treadmill 10; more specifically, the longitudinal axis 18 extends generally between the centerlines of a front shaft and a rear shaft, which will be discussed in more detail below.

[0024] A pair of side panels 24 and 26 (e.g., covers, shrouds, etc.) are provided on the right and left sides of the base 12 to effectively shield the user from the components or moving parts of the treadmill 10. The base 12 is supported by multiple support feet 28, which will be described in greater detail below. A rearwardly extending handle 30 is provided on the rear end of the base 12 and a pair of wheels 32 are provided at the front end of the base 12, however, the wheels 32 are mounted so that they are generally not in contact with the ground when the treadmill is in an operating position. The user can easily move and relocate the treadmill 10 by lifting the rear of the treadmill base 12 a sufficient amount so that the multiple support feet 28 are no longer in contact with the ground, instead the wheels 32 contact the ground, thereby permitting the user to easily roll the entire treadmill 10. It should be noted that the left and right-hand sides of the treadmill and various components thereof are defined from the perspective of a forward-facing user standing on the running surface of the treadmill 10.

[0025] Referring to FIGS. 2–6, the base 12 is shown further including a frame 40, a front shaft assembly 44 positioned near a front portion 48 of the frame 40, and a rear shaft assembly 46 positioned near the rear portion 50 of frame 40, generally opposite the front portion 48. Specifically, the front shaft assembly 44 is coupled to the frame 40 at the front portion 48, and the rear shaft assembly 46 is coupled to the frame 40 at the rear portion 48 so that the frame supports these two shaft assemblies.

[0026] The frame 40 comprises longitudinally-extending, opposing side members, shown as a left-hand side member 52 and a right-hand side member 54, and one or more lateral or cross-members 56 extending between and structurally connecting the side members 52 and 54 according to an exemplary embodiment. Each side member 52, 54 includes an inner surface 58 and an outer surface 60. The inner surface 58 of the left-hand side member 52 is opposite to and faces the inner surface 58 of the right-hand side member 54. According to other exemplary embodiments, the frame may have substantially any configuration suitable for providing structure and support for the manual treadmill.

[0027] Similar to most motor-driven treadmills, the front shaft assembly 44 includes a pair of front running belt pulleys 62 interconnected with, and preferably directly mounted to, a shaft 64, and the rear shaft assembly 46 includes a pair of rear running belt pulleys 66 interconnected with, and preferably directly mounted to, a shaft 68. The front and rear running belt pulleys 62, 66 are configured to support and facilitate movement of the running belt 16. The running belt 16 is disposed about the front and rear running belt pulleys 62, 66, which will be discussed in more detail below. As the front and rear running belt pulleys 62, 66 are preferably fixed relative to shafts 64 and 68, respectively, rotation of the front and rear running belt pulleys 62, 66 causes the shafts 64, 68 to rotate in the same direction.

[0028] As noted above, the manual treadmill disclosed herein incorporates a variety of innovations to translate the forward force created by the user into rotation of the running belt and permit the user to maintain a substantially static fore and aft position on the running belt while running. One of the ways to translate this force is to configure the running belt 16 to be more responsive to the force generated by the user. For example, by minimizing the friction between the running belt 16 and the other relevant components of the treadmill 10, more of the force the user applies to the running belt 16 to propel themselves forward can be utilized to rotate the running belt 16.

[0029] Another way to counteract the user-generated force and convert it into rotational motion of the running belt 16 is to integrate a non-planar running surface, such as non-planar running surface 70. Depending on the configuration, non-planar running surfaces can provide a number of advantages. First, the shape of the non-planar running surface may be such that, when a user is on the running surface, the force of gravity acting upon the weight of the user's body helps rotate the running belt. Second, the shapes may be such that it creates a physical barrier to restrict or prevent the user from propelling themselves off the front end 20 of the treadmill 10 (e.g., acting essentially as a stop when the user positions their foot thereagainst, etc.). Third, the shapes of some of the non-planar running surfaces can be such that it facilitates the movement of the running belt 16 there along (e.g., because of the curvature, etc). Accordingly, the force the user applies to the running belt 16 is more readily able to be translated into rotation of the running belt 16.

[0030] As seen in FIGS. 1 and 4-5, the running surface 70 is generally non-planar and shown shaped as a substantially complex curve according to an exemplary embodiment.

The running surface can be generally divided up into three general regions, the front portion 72, which is adjacent to the front shaft assembly 44, the rear portion 74, which is adjacent to the rear shaft assembly 46, and the central portion 76, which is intermediate the front portion 72 and the rear portion 74. In the exemplary embodiment seen in FIGS. 1 and 4, the running surface 70 includes a substantially concave curve 80 and a substantially convex curve 82. At the front portion 72 of the running surface 70, the relative height or distance of the running surface 70 relative to the ground is generally increasing moving forward along the longitudinal axis 18 from the central portion 76 toward the front shaft assembly 44. This increasing height configuration provides one structure to translate the forward running force generated by the user into rotation of the running belt 16. To initiate the rotation of the running belt 16, the user places her first foot at some point along the upwardly-inclined front portion 72 of the running surface 70. As the weight of the user is transferred to this first foot, gravity exerts a downward force on the user's foot and causes the running belt 16 to move (e.g., rotate, revolve, advance, etc.) in a generally clockwise direction as seen in FIG. 1 (or counterclockwise as seen in FIG. 4). As the running belt 16 rotates, the user's first foot will eventually reach the lowest point in the non-planar running surface 70 found in the central portion 76, and, at that point, gravity is substantially no longer available as a counteracting source to the user's forward running force. Assuming a typical gait, at this point the user will place her second foot at some point along the upwardly-inclined front portion 72 of the running belt 16 and begin to transfer weight to this foot. Once again, as weight shifts to this second foot, gravity acts on the user's foot to continue the rotation of the running belt 16 in the clockwise direction as seen in FIG. 1. This process merely repeats itself each and every time the user places her weight-bearing foot on the running belt 16 at any position vertically above the lowest point of central portion 76 of the running surface 70 of the of the running belt 16. The upwardly-inclined front portion 72 of the running belt 16 also acts substantially as a physical stop, reducing the chance the user can inadvertently step off the front end 20 of the treadmill 10.

[0031] A user can generally control the speed of the treadmill 10 by the relative placement of her weight-bearing foot along the running belt 16 of the base 12. Generally, the rotational speed of the running belt 16 increases as greater force is applied thereto in the rearward direction. The generally upward-inclined shape of the front portion 72 thus provides an opportunity to increase the force applied to the running belt 16, and, consequently, to increase the speed of the running belt 16. For example, by increasing her

stride and/or positioning her weight-bearing foot vertically higher on the front portion 72 relative to the lowest portion of the running belt 16, gravity will exert a greater and greater amount of force on the running belt 16 to drive it rearwardly. In the configuration of the running belt 16 seen in FIG 1, this corresponds to the user positioning her foot closer to the front end 20 of the treadmill 10 along the longitudinal axis 18. This results in the user applying more force to the running belt 16 because gravity is pulling her mass downward along a greater distance when her feet are in contact with the front portion 72 of the running surface 70. As a result, the relative rotational speed of the belt 16 and the relative running speed the user experiences is increased.

[0032] Another factor which will increase the speed the user experiences on the treadmill 10 is the relative cadence the user assumes. As the user increases her cadence and places her weight-bearing foot more frequently on the upwardly extending front portion 72, more gravitational force is available to counteract the user-generated force, which translates into greater running speed for the user on the running belt 16. It is important to note that speed changes in this embodiment are substantially fluid, substantially instantaneous, and do not require a user to operate electromechanical speed controls. The speed controls in this embodiment are generally the user's cadence and relative position of her weight-bearing foot on the running surface. In addition, the user's speed is not limited by speed settings as with a driven treadmill.

[0033] In the embodiment seen in FIGS. 1-6, gravity is also utilized as a means for slowing the rotational speed of the running belt. At a rear portion 74 of the running surface 70, the distance of the running surface 70 relative to the ground generally increases moving rearward along the longitudinal axis 18 from the lowest point in the non-planar running surface 70. As each of the user's feet move rearward during her stride, the rear portion 74 acts substantially as a physical stop to discourage the user from moving too close to the rear end of the running surface. To this point, the user's foot has been gathering rearward momentum while moving from the front portion 72, into the central portion 76, and toward the rear portion 74 of the running surface 70. Accordingly, the user's foot is exerting a significant rearwardly-directed force on the running belt 16. Under Newton's first law of motion, the user's foot would like to continue in the generally rearward direction. The upwardly-inclined rear portion 74, interferes with this momentum and provides a force to counter the rearwardly-directed force of the user's foot by providing a physical barrier. As

the user's non-leading foot moves up the incline, the running surface 70 provides a force that counters the force of the user's foot, absorbing some of the rearwardly-directed force from the user and preventing it from being translated into increasing speed of the running belt 16. Also, gravity acts on the user's weight bearing foot as it moves upward, exerting a downwardly-directed force on the user's foot that the user must counter to lift their foot and bring it forward to continue running. In addition to acting as a stop, the rear portion 74 provides a convenient surface for the user to push off of when propelling themselves forward, the force applied by the user to the rear portion 74 being countered by the force the rear portion 74 applies to the user's foot.

[0034] One benefit of the manual treadmill according to the innovations described herein is positive environmental impact. A manual treadmill such as that disclosed herein does not utilize electrical power to operate the treadmill or generate the rotational force on the running belt. Therefore, such a treadmill can be utilized in areas distant from an electrical power source, conserve electrical power for other uses or applications, or otherwise reduce the "carbon footprint" associated with the operation of the treadmill.

[0035] A manual treadmill according to the innovations disclosed herein can incorporate one of a variety of shapes and complex contours in order to translate the user's forward force into rotation of the running belt or to provide some other beneficial feature or element. FIGS. 1 and 4-5, generally depict the curve defined by the running surface 70, specifically, substantially a portion of a curve defined by a third-order polynomial equation. The front portion 72 and the central portion 76 define the concave curve 80 and the rear portion 74 of the running surface 70 defines the convex curve 82. As the central portion 76 of the running surface 70 transitions to the rear portion 74, the concave curve transitions to the convex curve. In the embodiment shown, the curvature of the front portion 72 and the central portion 76 is substantially the same; however, according to other exemplary embodiments, the curvature of the front portion 72 and the central portion 76 may differ.

[0036] According to an exemplary embodiment, the relative length of each portion of the running surface may vary. In the exemplary embodiment shown, the central portion is the longest. In other exemplary embodiments, the rear portion may be the longest, the front portion may be shorter than the intermediate portion, or the front portion may be longer than the rear portion, etc. It should be noted that the relative length may be evaluated based on

the distance the portion extends along the longitudinal axis or as measured along the surface of the running belt itself.

[0037] One of the benefits of integrating one or more of the various curves or contours into the running surface is that the contour of the running surface can be used to enhance or encourage a particular running style. For example, a curve integrated into the front portion of the running surface can encourage the runner to run on the balls of her feet rather than having the heel strike the ground first. Similarly, the contour of the running surface can be configured to improve a user's running biomechanics and to address common running induced injuries (e.g., plantar fasciitis, shin splints, knee pain, etc.). For example, integrating a curved contour on the front portion of the running surface can help to stretch the tendons and ligaments of the foot and avoid the onset of plantar fasciitis.

[0038] A conventional treadmill which uses an electrical motor to provide the motive force to rotate a running belt consumes electrical energy. However, a treadmill which is adapted to manually provide the motive force to rotate the running belt has the capability of generating electrical power by tapping into the motion of the running belt. FIGS. 7–10 show the treadmill 10 adapted to generate electrical power according to an exemplary embodiment.

[0039] In an exemplary embodiment of the innovations disclosed herein, a power generation system 100 comprises a drive pulley 102 preferably interconnected to the running belt 16, a power transfer belt 104 interconnected to the drive pulley 102, a generator 106 interconnected to the drive pulley 102, an energy storage device shown as a battery 108 electrically connected to the generator 106, and a generator control board 110 electrically connected to the battery 108 and generator 106. The power generation system 100 is configured to transform the kinetic energy the treadmill user imparts to the running belt 16 to electrical power that may be stored and/or utilized to operate one or more electrically-operable devices (e.g., a display, a motor, a USB port, one or more heart rate monitoring pick-ups, a port for charging a mobile telephone or portable music device, etc.). It should be noted that, in some exemplary embodiments, energy storage devices other than batteries may be used (e.g., a capacitor, etc.).

[0040] The drive pulley 102 is coupled to a support element shown as the front shaft 64 such that the drive pulley 102 will generally move with substantially the same rotational

velocity as the front shaft 64 when a user operates the treadmill 10 according to an exemplary embodiment. The power transfer belt 104 under suitable tension rotationally couples the drive pulley 102 to the generator 106, thereby mechanically interconnecting the running belt 16 and the front shaft 64 to the generator 106. The power transfer belt 104 is disposed or received at least partially about an exterior surface 112 of the drive pulley 102 and at least partially about an exterior surface 116 of an input shaft 118 of the generator 106. Accordingly, as a user imparts rotational force to the running belt 16, the running belt 16 transfers this force to the front running belt pulleys 62 and the front shaft 64 to which the front running belt pulleys 62 are mounted. Because the drive pulley 102 is mounted to the front shaft 64, this element rotates with the front shaft 64. This rotational force is transferred from the drive pulley 102 to the power transfer belt 104, which is mounted under suitable tension on the drive pulley 102, which in turn causes rotation of the generator input shaft 118. Preferably, the diameter of the drive pulley 102 is larger than the diameter of the input shaft 118 of the generator 106, so the input shaft 118 rotates with greater rotational velocity than the drive pulley 102.

[0041] While this exemplary embodiment shows the drive pulley 102 coupled to the front shaft 64, it is to be understood that the drive pulley 102 can be coupled to any part or portion of the treadmill which moves in response to the input from the user. For example, according to another exemplary embodiment, the drive pulley may be coupled to the rear shaft. According to still other exemplary embodiments, the drive pulley can be coupled to any support element that can impart motion thereto as a result of a user driving the running belt of the manual treadmill.

[0042] The generator 106 is electrically interconnected with the battery 108, preferably by a conventional electrical wire (not shown). The generator 106 transforms the mechanical input from the running belt 16 into electrical energy. This electrical energy, produced by the generator 106 as a result of the manual rotation of the running belt 16, is then stored in the battery 108. The battery 108 can then be used to provide power to a wide variety of electrically-operable devices such as mobile telephones, portable music players, televisions, gaming systems, or performance data display devices. The generator depicted in FIGS. 7–8 is a conventional generator such as Model 900 as manufactured by Pulse Power Systems.

[0043] The battery 108 is electrically coupled to one or more outlets or jacks 120, preferably by a conventional electrical wire (not shown), and the jacks 120 are mounted to the treadmill frame 40 by a bracket 122. One or more of the jacks 120 are configured to receive an electrical plug or otherwise output power so that electrical power may be transferred from the battery 108 to an electrically-operable device.

[0044] In use, as the user imparts rotational force to the running belt 16, this force is input into the generator 106 as a result of the cooperation of the front shaft 64, the drive pulley 102, the power transfer belt 104 and the generator input shaft 118. This rotation of the generator input shaft 118 results in the creation of electrical power which is typically input into the battery 108 if the user is traveling at a speed equal to or greater than a predetermined speed, the predetermined speed being determined by the configuration of the power generation system 100.

[0045] In order to ensure that the rotational momentum inherent in the mass of the generator does not adversely impact the user's variable speed of rotation of the running belt 16 (and vice-versa), a motion restricting element shown as a one-way bearing 126 is preferably coupled to or incorporated with the power generator system 100 according to an exemplary embodiment. The one-way bearing 126 is configured to permit rotation of the drive pulley 102 in only one direction. The one-way bearing 126 is shown press fit into the drive pulley 102, having an inner ring 128 fixed relative to the front shaft 64 and an outer ring 130 fixed relative to the drive pulley 102. One or more snap rings 132 are provided to establish the side-to-side location of the drive pulley 102 and one-way bearing 126 along the front shaft 64, though, securing elements other than or in addition to the snap rings may also be used. According to other exemplary embodiments, the motion-restricting element may be any suitable motion-restricting element (e.g., a cam system, etc.).

[0046] The front shaft 64 further includes a keyway 134 formed therein that cooperates with a key 136 of the one-way bearing 126 to help impart the motion of the front shaft 64 to the drive pulley 102 according to an exemplary embodiment. As a user imparts rotational force (e.g., the clockwise direction as shown in FIGS. 7-8) to the running belt 16, the running belt 16 causes the front running belt pulleys 62 and the drive shaft 64 to rotate. The key 136 of the one-way bearing 126, which is press fit into the drive pulley 102, cooperates with the keyway 134 formed in the front shaft 64, causing the drive pulley 102 to rotate as a

result of the rotation of the front shaft 64. Stated otherwise, the rotational force of the front shaft 64 is transferred to the drive pulley 102 by the interaction of the keyway 134 and the key 136 of the one-way bearing 126, causing the drive pulley 102 to rotate.

[0047] As a user drives the treadmill 10, the generator 106 develops inertia. This inertia is desirably accommodated when a user of the treadmill 10 slows down or stops. The one-way bearing 126 is used to accommodate this inertia in the exemplary embodiment shown. The outer ring 128 of the one-way bearing 126 is rotatable in a clockwise direction (as seen in FIGS. 7-8) independent of the inner ring 130. As the user located on the running belt 16 slows, the front shaft 64 slows. Despite the slowing of the front shaft 64, the one-way bearing 126 allows the drive pulley 102 and elements mechanically coupled thereto, the power transfer belt 104 and the generator 106, to continue rotating until, as a result of friction and gravity, the rotation (or lack thereof) of the running belt 16 matches the rotation of the drive pulley 102, power transfer belt 104, generator input shaft 118 and internal elements of the generator 106 coupled thereto. In this way, the one-way bearing helps prevent the generator 106 from being damaged by the user stopping too quickly and/or the preventing a loss of user control over the speeding up and slowing down of the treadmill 10.

[0048] In the exemplary embodiment shown in FIGS 8 and 9, the battery 108 is electrically interconnected with a display 138 by a conventional electrical wire, providing power thereto during operation of the treadmill 10. The generator control board 110 interfaces with the generator 106 and the display 138 in order to regulate the power provided to the display 138 and/or other electrically-operable devices coupled to the generator 106. The display 138 is configured to provide the performance-related data to the user in a user-readable format which may include, but is not limited to, operation time, current speed, calories burned, power expended, maximum speed, average speed, heart rate, etc.

[0049] According to an exemplary embodiment, the display 138 cooperates with the power generation system 100 to allow a user to enter and establish a maximum speed. For example, a user may enter a maximum speed of 5 mph using the controls of the display 138. The information regarding the maximum speed is provided by the control board of the display 138 to the generator control board 110. When the user reaches 5 mph, a braking system incorporated with the generator 106 will engage and limit the speed at which the

running belt 16 can move. In these exemplary embodiments, the braking system of the generator 106 limits the speed at which the running belt 16 can move by controlling the speed at which the input shaft 118 can rotate. In this embodiment, when the generator control board 110 recognizes that the generator 106 is operating at a level that exceeds the level that corresponds to a speed of 5 mph, the generator control board 110 will operably prevent the input shaft 118 from rotating with a rotational velocity that will exceed 5 mph. By controlling the rotational velocity of the input shaft 118, the rotational velocity of the drive pulley 102 can be slowed or limited via the power transfer belt 104, thereby slowing or limiting the rotational speed of the front shaft 64, the front running belt pulley 62, and finally the running belt 16. According to one exemplary embodiment, the braking system incorporated with the generator 106 is an eddy current braking system including one or more magnets. When the generator control board 110 signals the generator 106 that the maximum speed has been exceeded, more voltage is directed from the generator control board 110 to the generator 106, causing the magnets of the eddy current braking system to apply a greater force to the input shaft, making it more difficult to impart rotation thereto.

[0050] The one-way bearing 126 is mounted to accommodate this braking system. As noted previously, the one-way bearing 126 freely permits rotation in the clockwise direction as seen in FIGS 8 and 9 of running belt relative to the drive pulley 102, power transfer belt 104 and generator input shaft 118, but restricts or prevents rotation in the counterclockwise direction as seen in FIGS 8 and 9 of running belt 16 relative to the drive pulley 102, power transfer belt 104 and generator input shaft 118. So, as a user increases the speed of rotation of the running belt 16, the one-way bearing 126 is engaged so that the speed of rotation of the drive pulley 102, power transfer belt 104 and generator input shaft 118 similarly increase. If the user slows down the speed of rotation before hitting the maximum speed input as noted above, the one-way bearing 126 will disengage or release so that the relative inertia of rotation of the generator 106 along with the drive pulley 102, power transfer belt 104 and generator input shaft 118 will not interfere with the user slowing the speed of rotation of the running belt. However, if the user increases the speed of rotation up to the maximum speed, the braking system integrated into the generator 108 will eventually restrict the rotation of the drive pulley 102, power transfer belt 104 and generator input shaft 118. As the user attempts to increase the speed of rotation of the running belt 16 beyond the maximum speed the brake within the generator 108 will restrict the speed of rotation of the generator input shaft 118 which will in turn translate this speed restriction to the power

transfer belt 104 and drive pulley 102. The continued urging of the user to increase the speed of the running belt 16 causes the one-way bearing 126 to remain engaged thereby limiting the speed of rotation of the shaft 64 to that of the drive pulley 102. Once the maximum speed is met, the user will be forced to reduce the speed, otherwise, she will have excess forward velocity.

[0051] FIG. 10 provides a system diagram of the power generation system 100. The power generation system 100 is shown including two electrically connected control boards, the generator control board 110 and the control board incorporated with the display 138.

[0052] As discussed above, the generator control board 110 electrically connects the generator 106, the battery 108, and the one or more jacks 120. In the exemplary embodiment shown, the jacks 120 include a first jack 140 configured to output DC power to electrically operable devices or equipment and a second jack 142 configured to connect to a charging device suitable for recharging the battery 108 if it is fully discharged.

[0053] The control board of the display 138 electrically connects one or more sensors adapted monitor the user's heart rate and one or more jacks or ports for interconnecting electrical devices according to an exemplary embodiment. In the exemplary embodiment shown in FIG. 10, the sensors adapted to monitor the user's heart rate include a first wireless heart monitor 144 that monitors the user's heart rate from a conventional chest strap and a second contact heart monitor 146 that monitors the user's heart rate when the user's hands are positioned on one or more sensor plates or surfaces (e.g., a sensor plate on the handrail 14). The one or more jacks or ports are shown as a USB jack charger 148 configured to connect to and charge any of a variety of devices chargeable via a USB connector and a port shown as an RS-232 port 150, which enables data gathered and stored by the treadmill 10 to be downloaded into a computer.

[0054] In the exemplary embodiment shown, the drive pulley 102, the power transfer belt 104, the generator 106, the battery 108, and the generator control board 110 are shown disposed proximate to the left-hand side member 52. In another exemplary embodiment, these components are disposed proximate the outer surface 60 of the right-hand side member 54. According to other exemplary embodiments, one or more of the components may be disposed on opposite sides of the frames 40 and/or at other locations.

[0055] Referring to FIG. 11, a drive motor 200 may be used with or integrated with the power generation system 100 according to an exemplary embodiment. The drive motor 200 is configured to help drive the running belt 16 in certain circumstances. For example, the user may select a setting wherein the running belt 16 is to be maintained at a desired speed and does not rely on the user to drive the running belt 16. In the exemplary embodiment shown, the drive motor 200 does not receive power from the battery 108 in order to operate. Rather, the drive motor that has its own power source that is electrically independent of the power generation system 100. However, in other exemplary embodiments, the drive motor may receive power from a power storage device (e.g., battery 108) of the power generation system in order to operate.

[0056] Referring further to FIG. 11, the drive motor 200 is operably coupled to the running belt 16 by a motor belt 202 according to an exemplary embodiment. The motor belt 202 extends about an output shaft 204 of the drive motor 200 and a second drive pulley 206 that is coupled to the rear shaft 68 by a centrally-disposed bushing 208. When the output shaft 204 of the drive motor 200 rotates, it imparts rotational motion to the motor belt 202, which, in turn imparts rotational motion to the second drive pulley 206. The second drive pulley 206, being substantially fixed relative to the rear shaft 68, causes the rear shaft 68 to rotate. The rotation of the rear shaft 68 then causes the rear running belt pulleys 66 and the running belt 16 to rotate.

[0057] According to an exemplary embodiment, the treadmill 10 includes two drive motors, one associated with each of the front shaft 64 and the rear shaft 68. Among other applications, the drive motors may be used to control the relative speeds of the front shaft 64 and the rear shaft 68. Typically, the relative speed of the front shaft 64 and the rear shaft 68 is controlled to synchronize the rotational velocities of the shafts.

[0058] Referring to FIG. 12, the treadmill 10 includes one or more drive motors 200, but does not include a power generation system according to an exemplary embodiment.

[0059] Referring to FIG. 13, the treadmill 10 includes a motor 302 configured to provide power to an elevation adjustment system 300 according to an exemplary embodiment. The motor 302 may be used to alter the incline of the base 12 of the treadmill 10 relative to the ground. The front shaft 64 may be lowered relative to the rear shaft 68 and/or the front shaft 64 may be raised relative to the rear shaft 68 using electrical controls. Further, a user

may not have to dismount from the treadmill in order to impart this adjustment. For example, the elevation adjustment system may include controls that are integral with the above-discussed display 134. Alternatively, the controls may be integrated with the handrail 14 or be disposed at another location that is easily accessed by the user when operating the treadmill 10. In some exemplary embodiments, the motor for the elevation adjustment system is at least in-part powered by a power storage device (e.g., battery 108) of the power generation system.

[0060] FIG. 13 illustrates a number of components of the exemplary elevation adjustment system 300. When assembled, a drive belt or chain 304 of the drive motor 302 is operably connected to an internal connecting shaft assembly 306 at a sprocket 308. The sprocket 308 is fixed relative to an internal connecting shaft 310 of the internal connecting shaft assembly 306. By imparting rotational motion to the drive belt or chain 304 via an output shaft 312, the drive motor 200 causes the sprocket 308 and the internal connecting shaft 310 to rotate. The internal connecting shaft assembly 306 further includes a pair of drive belts or chains 314 that are operably coupled to gears 316 of rack and pinion blocks 318. The rotation of the internal connecting shaft 310 causes the drive belts or chains 314 to rotate gears 316. As the gears 316 rotate, a pinion (not shown) disposed within the rack and pinion blocks 318 imparts linear motion to the racks 320, thereby operably raising or lowering the base 12 of the treadmill 10 depending on the direction of rotation of the output shaft 312 of the drive motor 302. According to other exemplary embodiments, any suitable linear actuator may serve as an elevation adjustment system for the manual treadmill disclosed herein.

[0061] Referring back to FIG. 10, the generator control board 110 also electrically connects components of an elevation adjustment system 300. Specifically, the generator control board 110 electrically connects the motor 302 of the elevation adjustment system 300, an incline feedback system 322 including a potentiometer that is conventional in the art, and one or more elevation limit switches 324 which limit the maximum and minimum elevation of the base 12 of the treadmill by acting as a safety stop. The motor 302 is further shown incorporating a capacitor start module 326 and an electromechanical brake 328, which are also electrically connected to the generator control board 110.

[0062] As utilized herein, the terms “approximately,” “about,” “substantially,” and similar terms are intended to have a broad meaning in harmony with the common and accepted

usage by those of ordinary skill in the art to which the subject matter of this disclosure pertains. It should be understood by those of skill in the art who review this disclosure that these terms are intended to allow a description of certain features described and claimed without restricting the scope of these features to the precise numerical ranges provided. Accordingly, these terms should be interpreted as indicating that insubstantial or inconsequential modifications or alterations of the subject matter described and are considered to be within the scope of the disclosure.

[0063] It should be noted that the term “exemplary” as used herein to describe various embodiments is intended to indicate that such embodiments are possible examples, representations, and/or illustrations of possible embodiments (and such term is not intended to connote that such embodiments are necessarily extraordinary or superlative examples).

[0064] For the purpose of this disclosure, the term “coupled” means the joining of two members directly or indirectly to one another. Such joining may be stationary or moveable in nature. Such joining may be achieved with the two members or the two members and any additional intermediate members being integrally formed as a single unitary body with one another or with the two members or the two members and any additional intermediate members being attached to one another. Such joining may be permanent in nature or may be removable or releasable in nature.

[0065] It should be noted that the orientation of various elements may differ according to other exemplary embodiments, and that such variations are intended to be encompassed by the present disclosure.

[0066] It is important to note that the constructions and arrangements of the manual treadmill as shown in the various exemplary embodiments are illustrative only. Although only a few embodiments have been described in detail in this disclosure, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter recited in the claims. For example, elements shown as integrally formed may be constructed of multiple parts or elements, the position of elements may be reversed or otherwise varied, and the nature or number of discrete elements or positions may be

altered or varied. The order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. Other substitutions, modifications, changes and omissions may also be made in the design, operating conditions and arrangement of the various exemplary embodiments without departing from the scope of the present disclosure.

WHAT IS CLAIMED IS:

1. A manually operated treadmill adapted to generate electrical power comprising:
 - a treadmill frame;
 - a running belt supported upon the treadmill frame and adapted for manual rotation; and
 - an electrical power generator mechanically interconnected to the running belt and adapted to convert the manual rotational motion of the running belt into electrical power.
2. The manually operated treadmill of claim 1 and further comprising a battery electrically connected to the generator and adapted to store the electrical power produced by the generator as a result of the manual rotation of the running belt.
3. The manually operated treadmill of claim 2 and further comprising an electrical outlet electrically connected to the battery, the outlet being adapted to be electrically connected to another electrical powered device.
4. The manually operated treadmill of claim 3 wherein the electrical outlet is adapted to receive a USB connection
5. The manually operated treadmill of claim 2 and further comprising an electrical display panel being adapted to display performance data and which is electrically connected to the battery so that the battery is the sole source of electrical power for the display panel.
6. The manually operated treadmill of claim 1 and further comprising:
 - a first shaft supported upon the treadmill frame and rotationally interconnected to the running belt; and
 - a power transfer belt adapted to rotationally interconnect the first shaft to the generator so that the rotational movement of the running belt is transferred to the first shaft and in turn transferred to the generator.

7. The manually operated treadmill of claim 6 and further comprising a first pulley mounted to the first shaft, the first pulley being adapted to receive and support the power transfer belt.

8. The manually operated treadmill of claim 7 and further comprising a one way bearing adapted to support the first pulley on the first shaft and permit rotation of the first pulley relative to the first shaft in one rotational direction and resist rotation of the first pulley relative to the first shaft in the opposite rotational direction.

9. The manually operated treadmill of claim 8 and further comprising a braking system coupled to the generator and adapted to limit the speed of rotation of the running belt

10. The manually operated treadmill of claim 1 and further comprising a braking system coupled to the generator and adapted to limit the speed of rotation of the running belt.

11. A treadmill comprising:

a treadmill frame;

a support member rotationally supported upon the treadmill frame;

a running belt supported by and interconnected to the support member, the running belt being mounted solely for manual rotation about the support member;

an electrical power generator adapted to convert rotational movement into electrical power; and

a power transfer belt mounted to interconnect the electrical power generator to the support member so that the rotational movement of the support member is transferred to the electrical power generator which in turn creates electrical power.

12. The treadmill of claim 11 and further comprising a battery electrically connected to the electrical power generator and adapted to store the electrical power produced by the generator as a result of the manual rotation of the running belt.

13. The treadmill of claim 12 and further comprising an electrical outlet electrically connected to the battery, the outlet being adapted to receive an electrical plug so that electrical power may be transferred from the battery to another device.

14. The treadmill of claim 12 and further comprising an electrical display panel being adapted to calculate and display performance data and being electrically connected to the battery so that the battery is the sole source of electrical power for the display panel.

15. The treadmill of claim 11 and further comprising an electrical display panel being adapted to calculate and display performance data and being electrically connected to the generator.

16. The treadmill of claim 11 and further comprising:
a first shaft supported upon the treadmill frame and rotationally interconnected to the running belt; and
a power transfer belt adapted to rotationally interconnect the first shaft to the generator so that the rotational movement of the running belt is transferred to the first shaft and in turn transferred to the generator.

17. The treadmill of claim 16 and further comprising a first pulley mounted to the first shaft, the first pulley being adapted to receive and support the power transfer belt.

18. The treadmill of claim 17 and further comprising a one way bearing adapted to support the first pulley on the first shaft and permit rotation of the first pulley relative to the first shaft in one rotational direction and resist rotation of the first pulley relative to the first shaft in the opposite rotational direction.

19. The treadmill of claim 11 and further comprising a braking system coupled to the generator and adapted to limit the speed of rotation of the running belt.

20. The treadmill of claim 19 and further comprising a braking system coupled to the generator and adapted to limit the speed of rotation of the running belt.

21. The treadmill of claim 11 and further comprising:

a height adjusting motor supported by the treadmill frame and electrically powered by the generator; and

at least one height adjustable foot supported by the treadmill frame and interconnected to the height adjusting motor, the at least one height adjusting foot being adapted to alter the relative incline of at least a portion of the running belt in response to operation of the height adjusting motor.

22. A method of providing power to a treadmill comprising the steps:

providing

a treadmill frame;

a support member rotationally supported upon the treadmill frame;

a running belt supported by and interconnected to the support member, the running belt being mounted solely for manual rotation about the support member;

an electrical power generator supported on the treadmill frame being adapted to convert rotational movement into electrical power;

a power transfer belt adapted to interconnect the electrical power generator and the support member so that the rotational movement of the support member is transferred to the electrical power generator which in turn creates electrical power; and

an electrical display panel being adapted to calculate and display performance data relating to operation of the treadmill; and

electrically interconnecting the electrical power generator to a display panel so that the electrical power necessary to operate the electrical display panel is supplied by the power generator.

23. A method of providing power to a treadmill according to claim 22 and further comprising the step of providing a battery intermediate the electrical power generator and the electrical display panel and electrically connecting the power generator to the battery and the battery to the electrical display panel

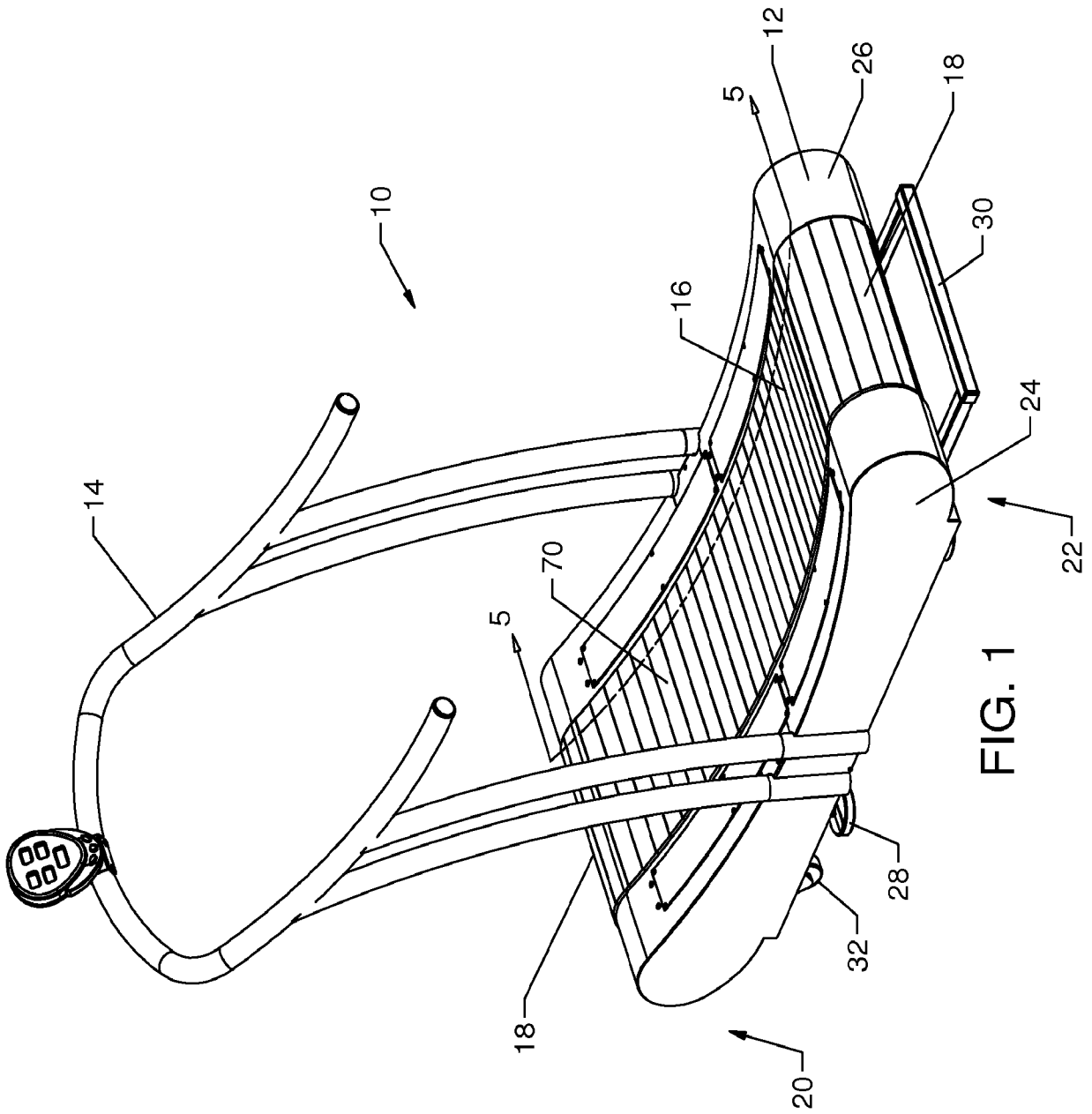


FIG. 1

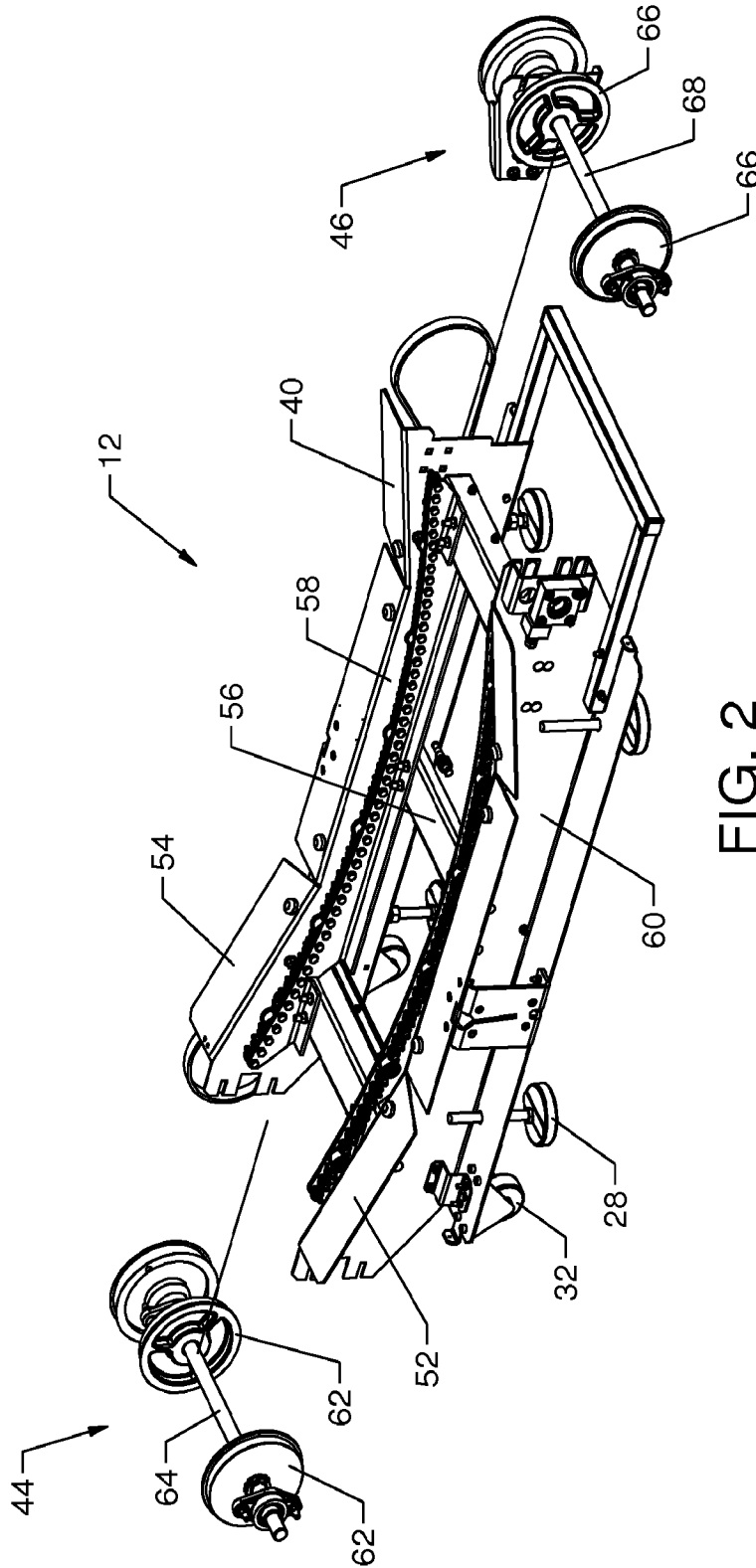


FIG. 2

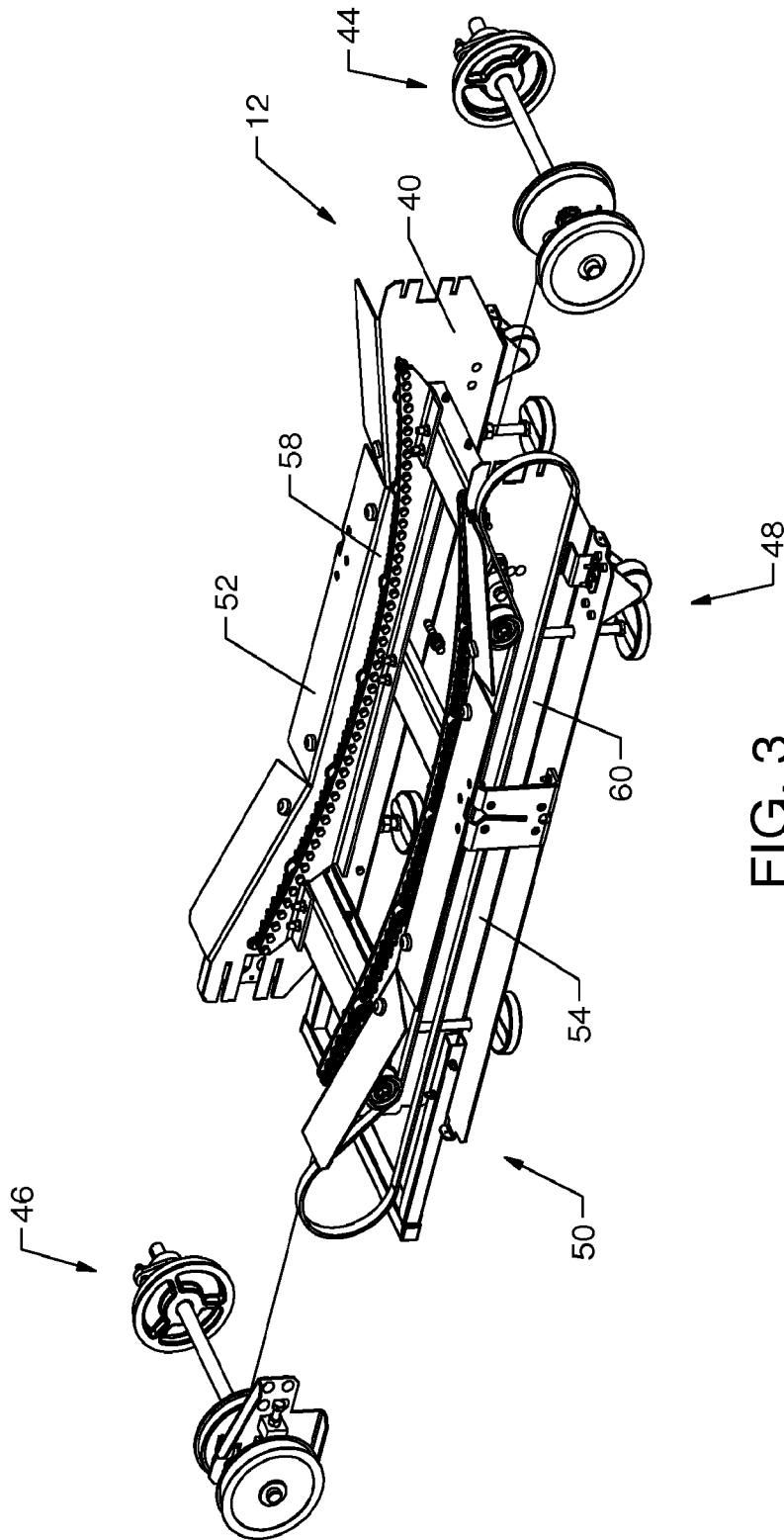


FIG. 3

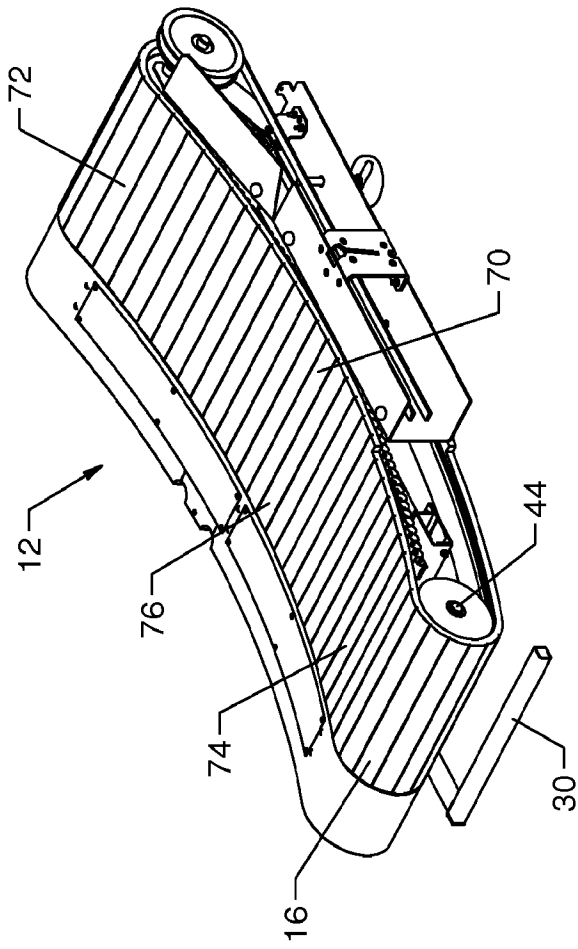


FIG. 4

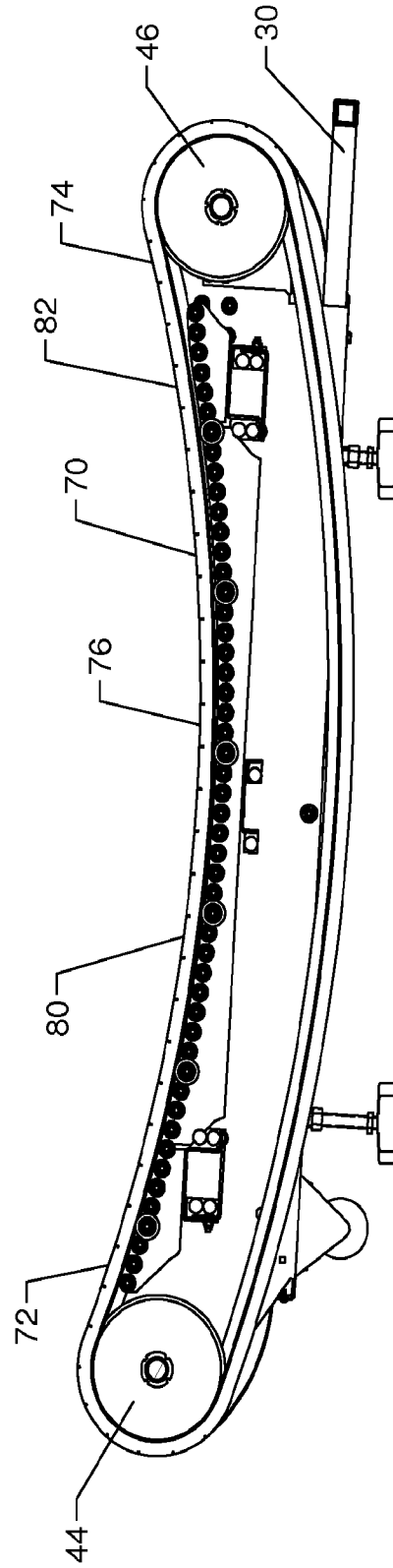


FIG. 5

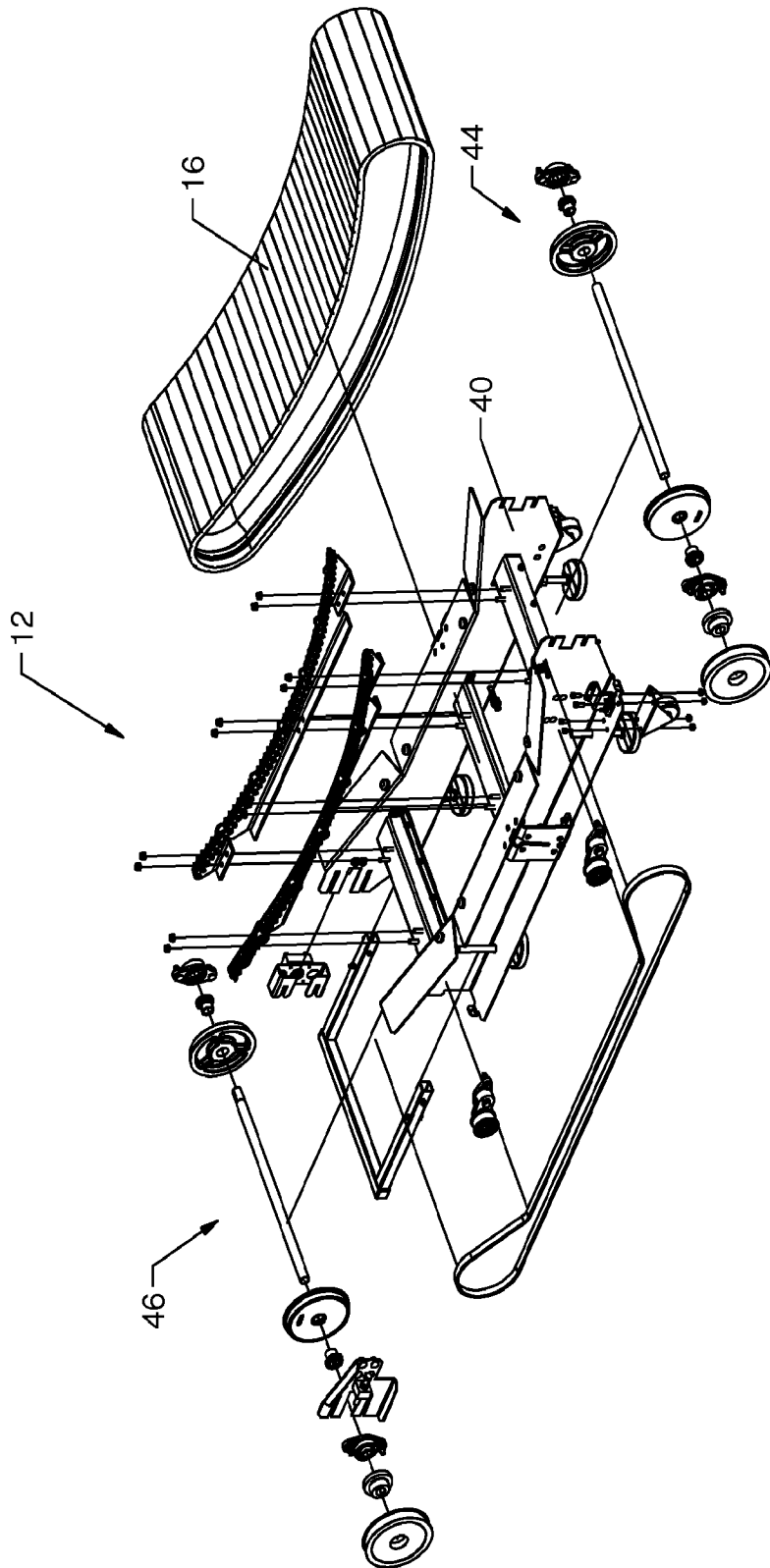


FIG. 6

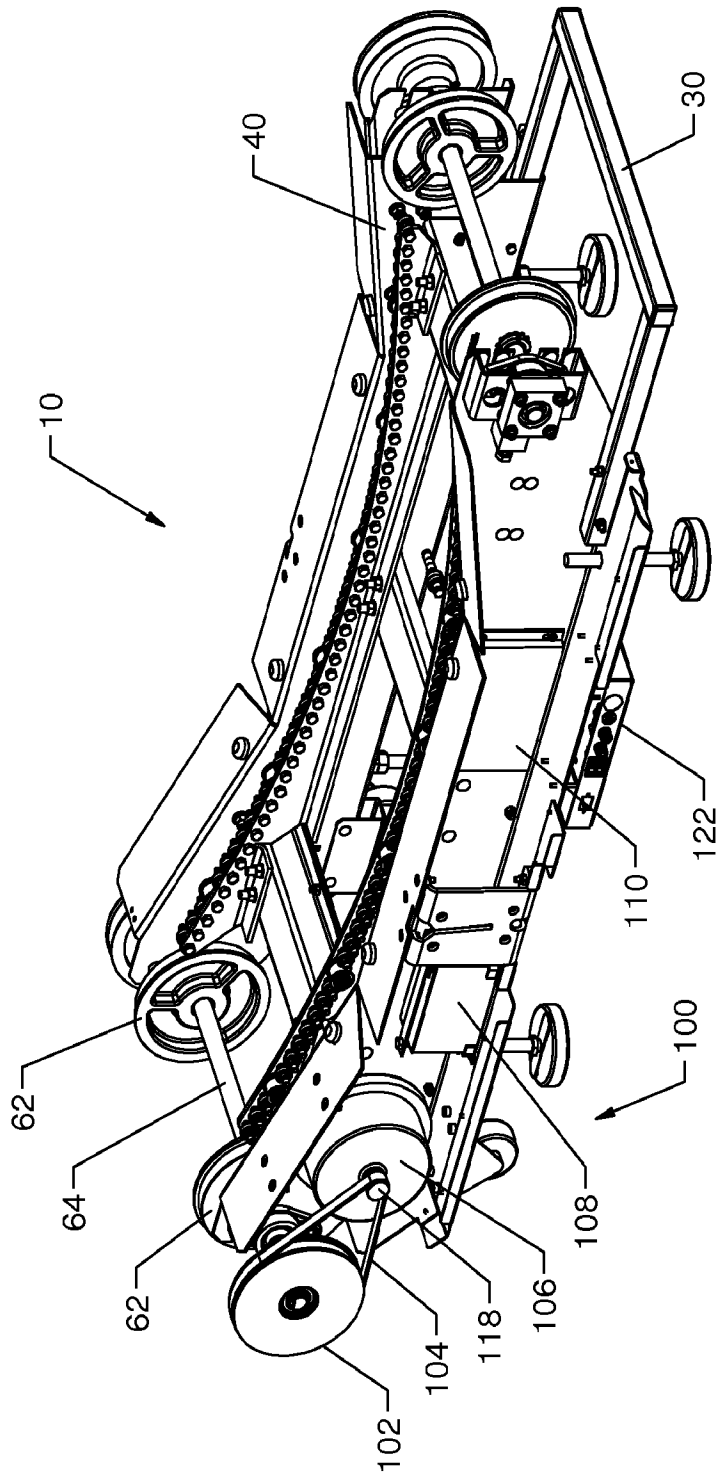


FIG. 7

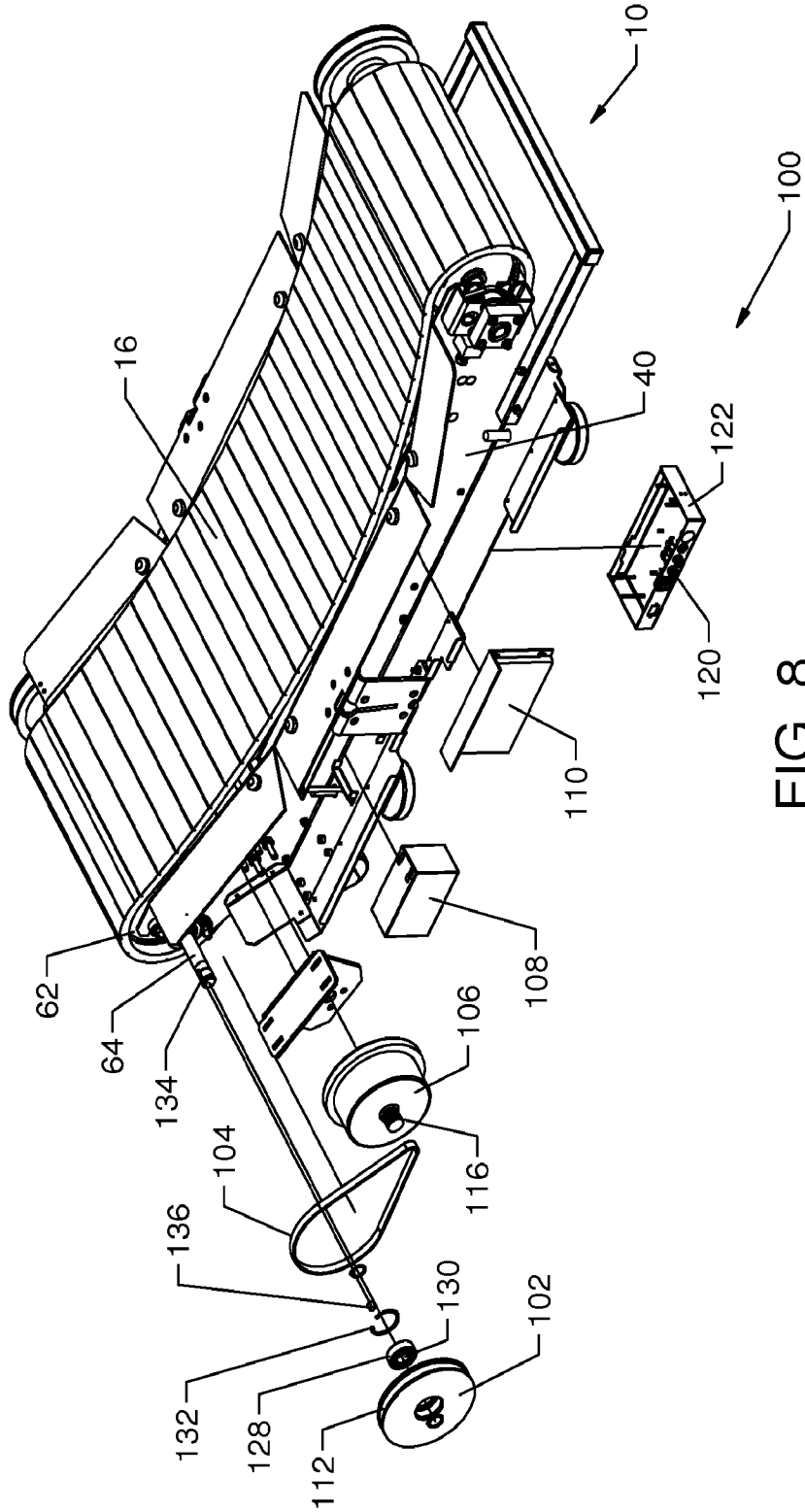


FIG. 8

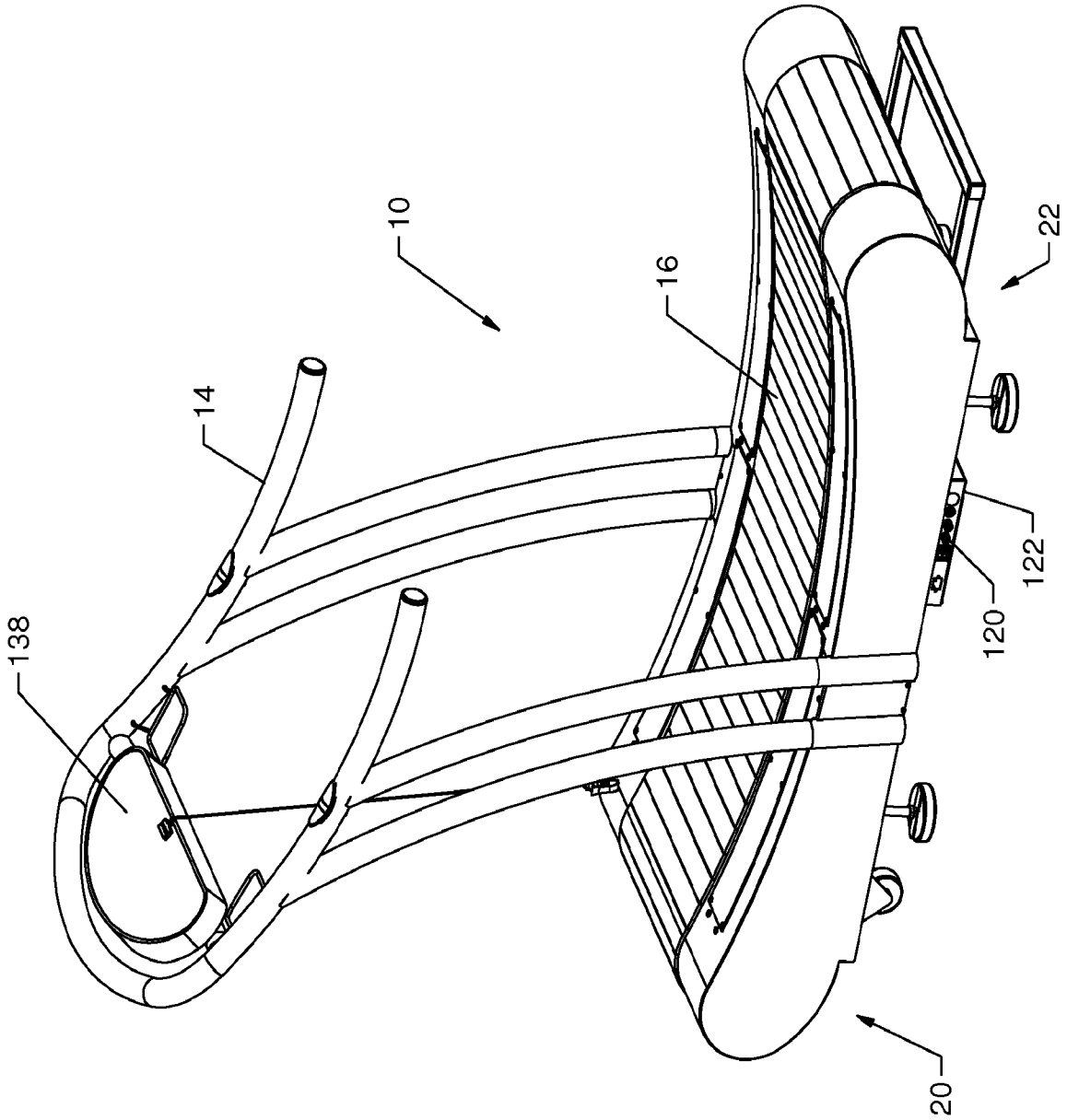


FIG. 9

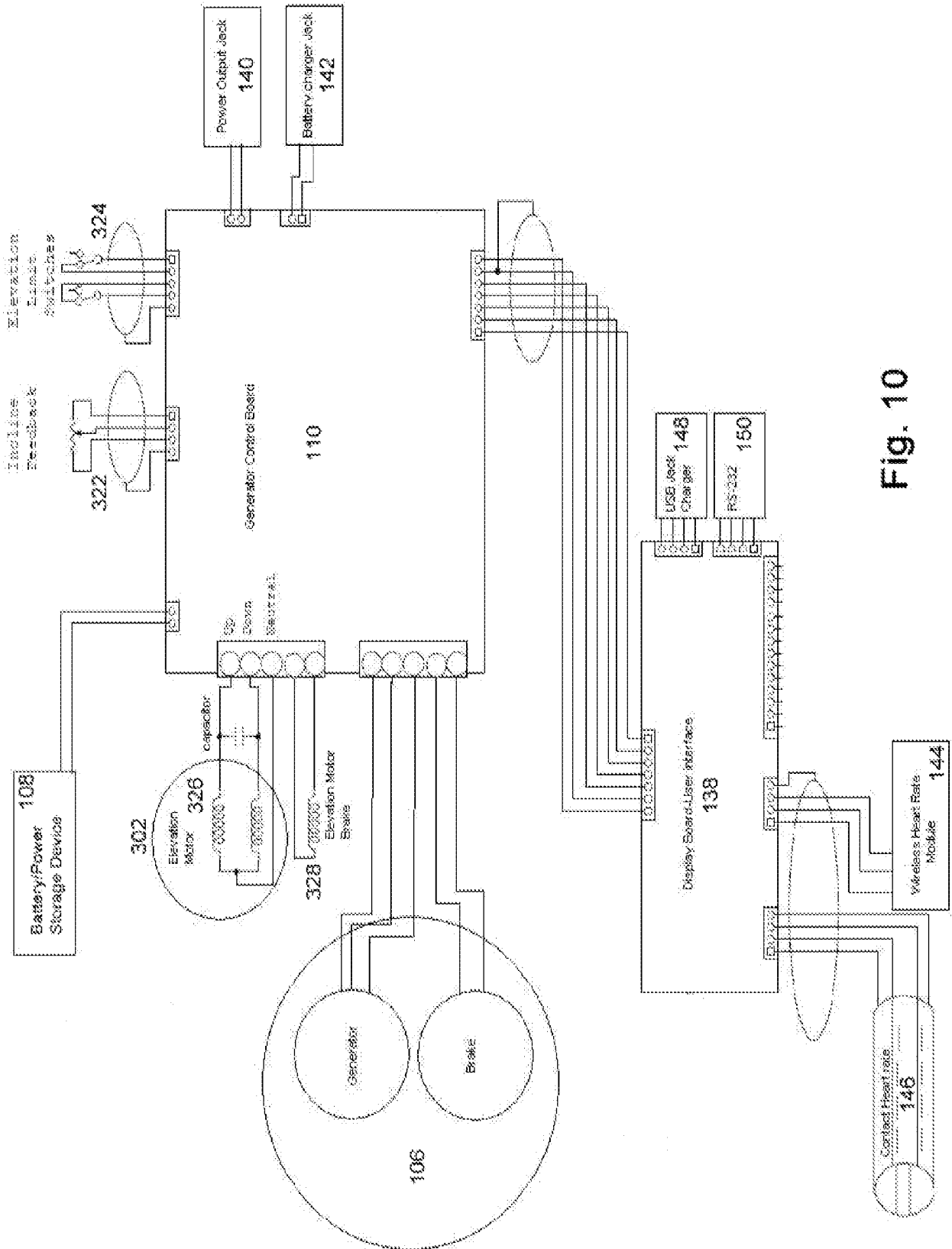


Fig. 10

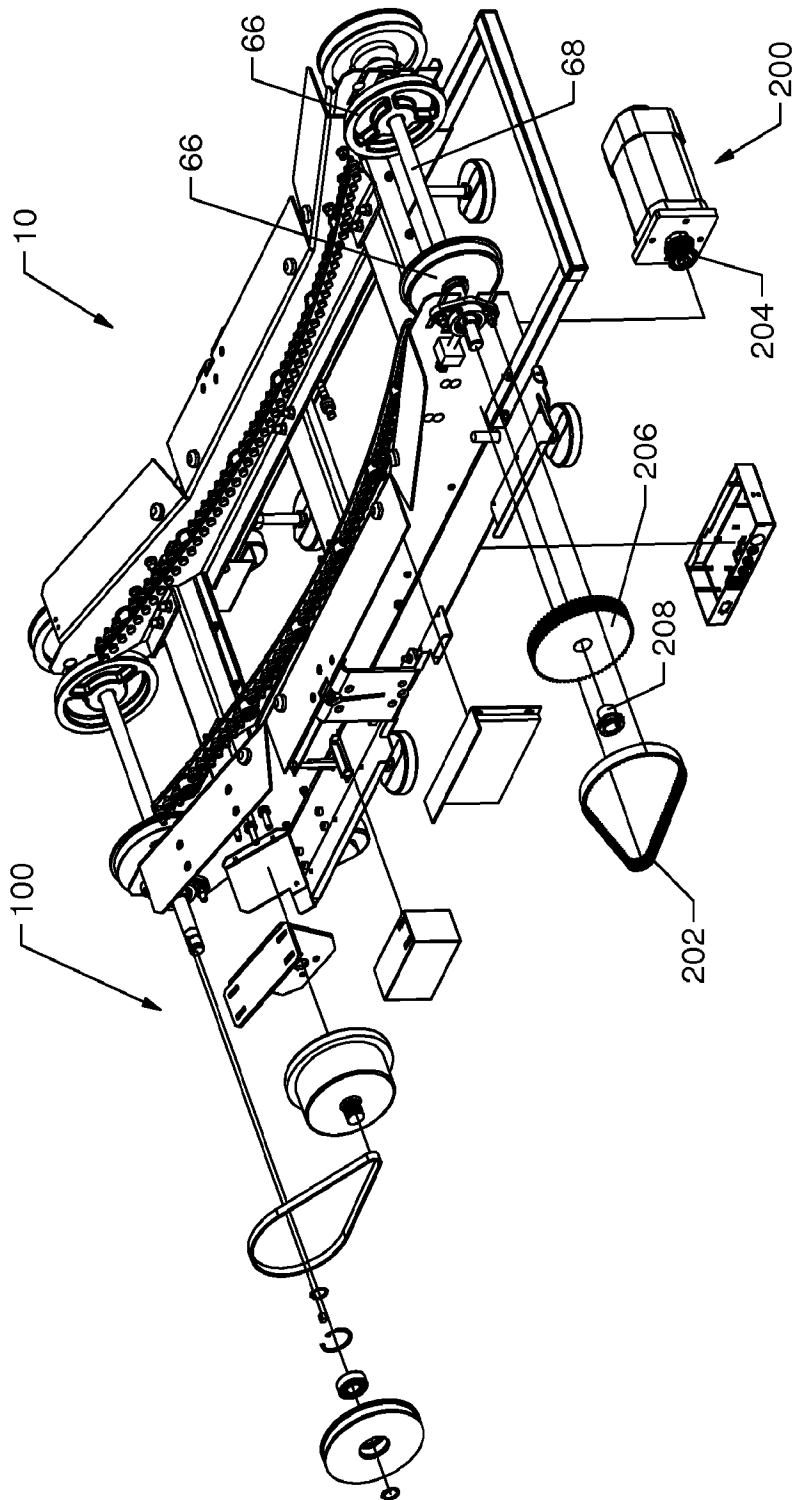


FIG. 11

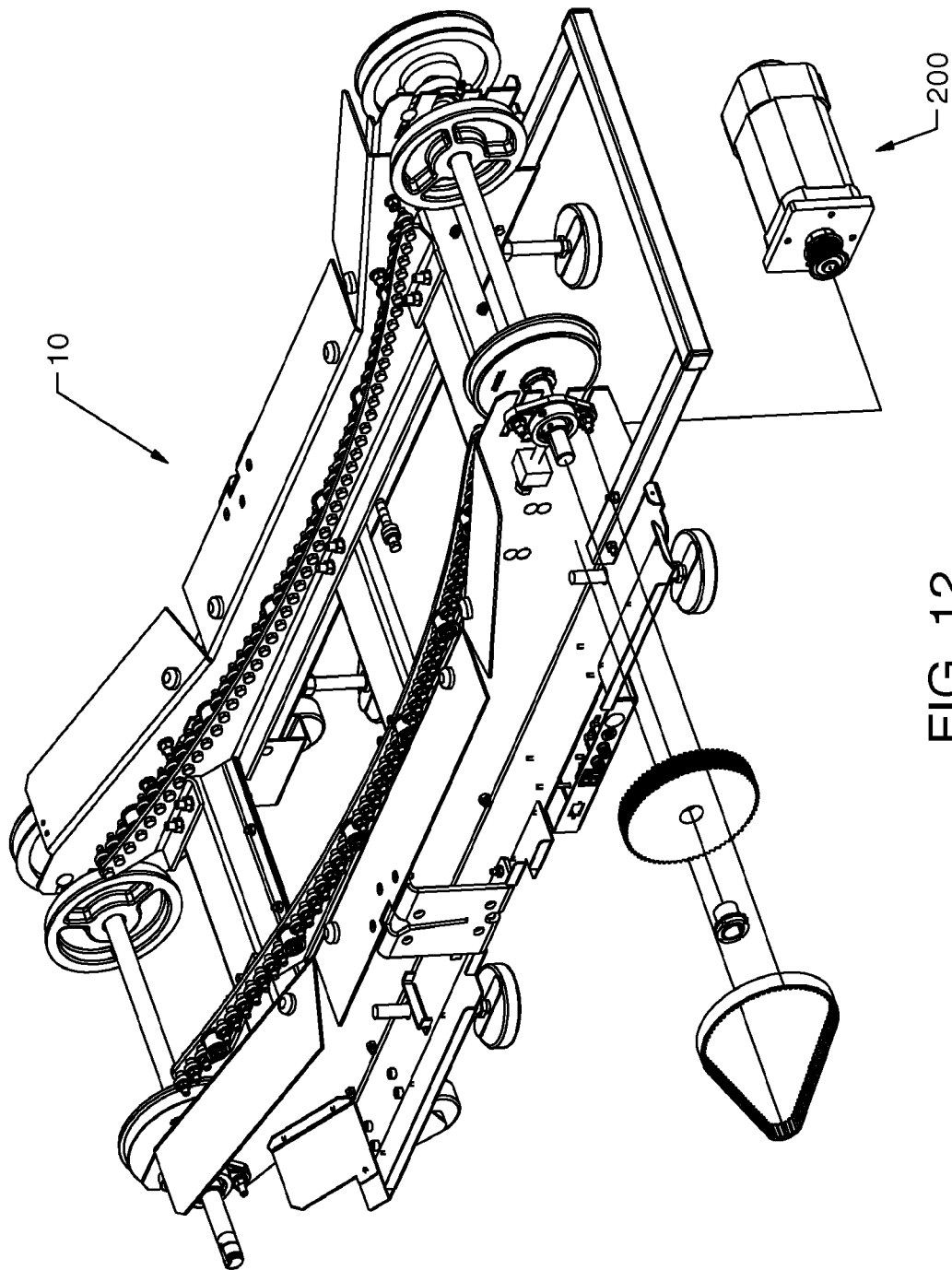


FIG. 12

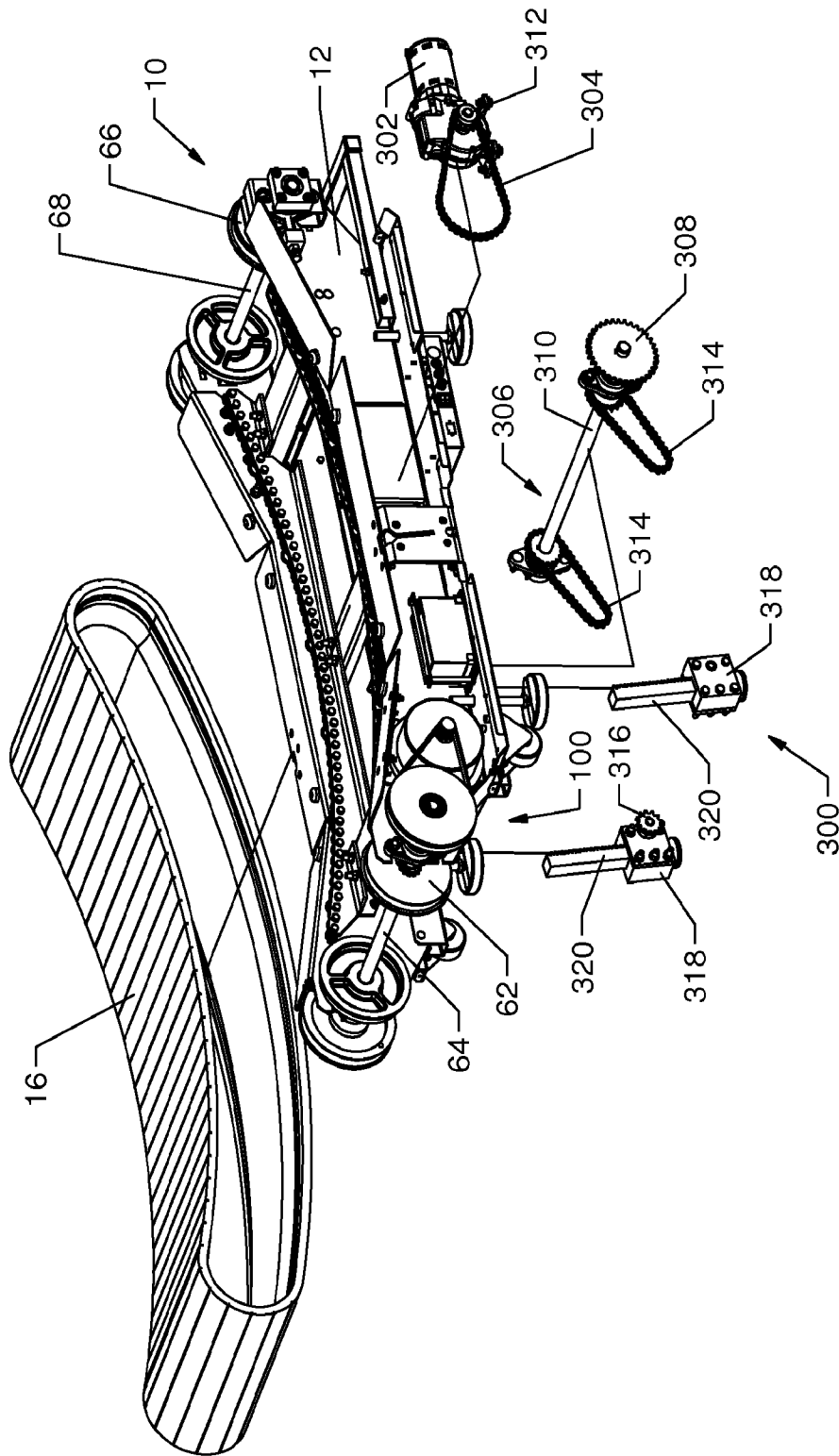


FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2010/026731

<p>A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - A63B 22/02 (2010.01) USPC - 482/2 According to International Patent Classification (IPC) or to both national classification and IPC</p>																										
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) IPC(8) - A63B 22/02; F03G 5/00, 5/04; H02K 7/18 (2010.01) USPC - 119/700; 482/2, 54</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatBase; Google Patents</p>																										
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>US 2008/0287266 A1 (SMITH) 20 November 2008 (20.11.2008) entire document</td> <td>1-5, 10</td> </tr> <tr> <td>---</td> <td></td> <td>-----</td> </tr> <tr> <td>Y</td> <td></td> <td>6-9, 11-23</td> </tr> <tr> <td>Y</td> <td>US 2002/0147079 A1 (KALNBACH) 10 October 2002 (10.10.2002) entire document</td> <td>6-9, 11-23</td> </tr> <tr> <td>A</td> <td>CN 2860541 Y (SUN) 24 January 2007 (24.01.2007) entire document</td> <td>1-23</td> </tr> <tr> <td>A</td> <td>CN 201006229 Y (DEWEI) 16 January 2008 (16.01.2008) entire document</td> <td>1-23</td> </tr> <tr> <td>A</td> <td>CN 201030178 Y (FU et al) 05 March 2008 (05.03.2008) entire document</td> <td>1-23</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	US 2008/0287266 A1 (SMITH) 20 November 2008 (20.11.2008) entire document	1-5, 10	---		-----	Y		6-9, 11-23	Y	US 2002/0147079 A1 (KALNBACH) 10 October 2002 (10.10.2002) entire document	6-9, 11-23	A	CN 2860541 Y (SUN) 24 January 2007 (24.01.2007) entire document	1-23	A	CN 201006229 Y (DEWEI) 16 January 2008 (16.01.2008) entire document	1-23	A	CN 201030178 Y (FU et al) 05 March 2008 (05.03.2008) entire document	1-23
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																								
X	US 2008/0287266 A1 (SMITH) 20 November 2008 (20.11.2008) entire document	1-5, 10																								
---		-----																								
Y		6-9, 11-23																								
Y	US 2002/0147079 A1 (KALNBACH) 10 October 2002 (10.10.2002) entire document	6-9, 11-23																								
A	CN 2860541 Y (SUN) 24 January 2007 (24.01.2007) entire document	1-23																								
A	CN 201006229 Y (DEWEI) 16 January 2008 (16.01.2008) entire document	1-23																								
A	CN 201030178 Y (FU et al) 05 March 2008 (05.03.2008) entire document	1-23																								
<p><input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/></p>																										
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"E" earlier application or patent but published on or after the international filing date</td> <td>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td>"&" document member of the same patent family</td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	"P" document published prior to the international filing date but later than the priority date claimed															
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention																									
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone																									
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art																									
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family																									
"P" document published prior to the international filing date but later than the priority date claimed																										
<p>Date of the actual completion of the international search 17 April 2010</p>		<p>Date of mailing of the international search report 04 MAY 2010</p>																								
<p>Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201</p>		<p>Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774</p>																								