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(54) Total body elliptical exercise equipment with upper body monitoring

(57) An exercise device in accordance with the present invention includes a frame defining a longitudinal axis, with the frame having a rearward portion and a forward portion. A guide track and a foot link are provided. The foot link includes a rearward portion that is constrained to move in an orbital path approximately parallel to the longitudinal axis and a forward portion that reciprocally engages the guide track. A swing arm is provided having a pivotal connection to the frame. The swing arm includes an upper portion extending above the pivotal connection and a lower portion disposed below the pivotal connection. An engagement mechanism includes a first portion coupled to the lower portion of the swing arm and a second portion coupled to the forward portion of the foot link. A rearward force applied to the upper portion of the swing arm produces a force on the forward portion of the foot link having a downward component. A load monitoring mechanism is positioned to monitor the load applied to the swing arm.

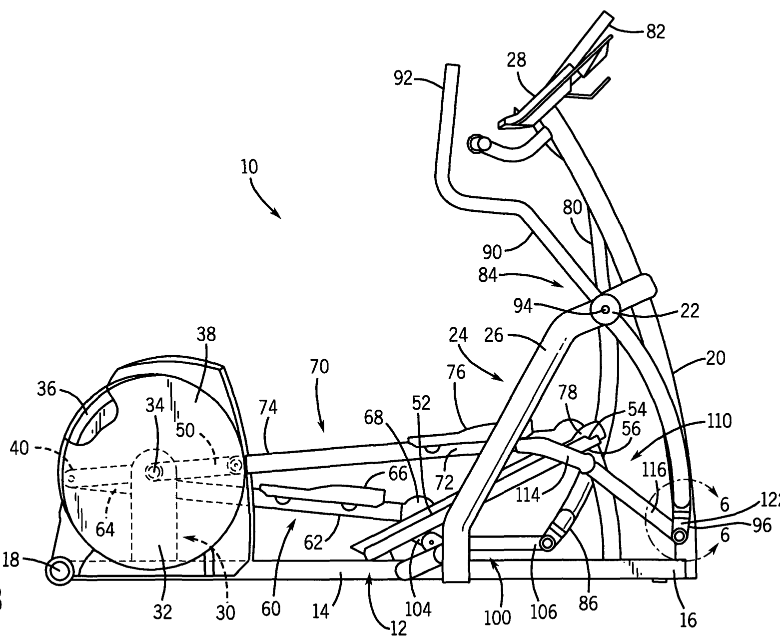

FIG. 3

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to exercise equipment.

BACKGROUND OF THE INVENTION

[0002] The benefits of regular aerobic exercise are well established. However, due to time constraints, inclement weather, and other reasons, many people are prevented from aerobic activities such as walking, jogging, running, and swimming. In response, a variety of exercise equipment has been developed for aerobic activity. It is generally desirable to exercise a large number of different muscles over a significantly large range of motion so as to provide for balanced physical development, to maximize muscle length and flexibility, and to achieve optimum levels of aerobic exercise. It is further advantageous for exercise equipment to provide smooth and natural motion, thus avoiding significant jarring and straining that can damage both muscles and joints.

[0003] While various exercise systems are known in the prior art, these systems suffer from a variety of shortcomings that limit their benefits and/or include unnecessary risks and undesirable features. For example, stationary bicycles are a popular exercise system in the prior art; however, these machines employ a sitting position that utilizes only a relatively small number of muscles, through a fairly limited range of motion. Cross-country skiing devices are also utilized to simulate the gliding motion of cross-country skiing. While cross-country skiing devices exercise more muscles than stationary bicycles, the substantially flat shuffling foot motion provided by the ski devices limits the range of motion of some of the muscles being exercised. Another type of exercise device simulates stair climbing. These devices exercise more muscles than stationary bicycles; however, the rather limited range of up-and-down motion utilized does not exercise the user's leg muscles through a large range of motion. Treadmills are still a further type of exercise device in the prior art. Treadmills allow natural walking or jogging motions in a relatively limited area. A drawback of the treadmill, however, is that significant jarring of the hip, knee, ankle and other joints of the body may occur through use of this device.

[0004] A further limitation of a majority of exercise systems in the prior art lies in the limits in the types of motions that they can produce. Relatively new classes of exercise devices are capable of producing elliptical motion. Exercise systems create elliptical motion, as referred to herein, when the path traveled by a user's feet while using the exercise system follows an arcuate or ellipse-shaped path of travel. Elliptical motion is much more natural and analogous to running, jogging, walking, etc., than the linear-type, back and forth motions produced by some prior art exercise equipment.

[0005] Exercise devices that can provide arm and shoulder motions as well as arcuate foot motions are also desirable. Prior art devices utilize arm and shoulder motions that are linked to foot motions. These linked devices incorporate forced coordinated motion, where the motions of a user's feet are linked to the motions of a user's arms and shoulders. Thus, the user's feet are forced to move in response to the movement of the user's arms and shoulders (in substantially an equal and opposite amount), and vice versa. One drawback to these linked devices lies in the ability of the user during operation to unintentionally exert little or no force on the arm apparatuses. The arm apparatus travel through a given path regardless of whether the user is exerting any force on the arm due to the force being exerted on the foot links. The opposite drawback can also occur where too much force is exerted on the arm apparatus, thereby diminishing the amount of force exerted on the foot apparatuses.

[0006] What would thus be desirable is an exercise device that provides for smooth natural action, exercises a relatively large number of muscles through a large range of elliptical motion, employs arm, shoulder, and rotational movement, and provides for safety and stability. Such an exercise device would further inform the user whether a proper or desired amount of arm and shoulder force is being exerted.

SUMMARY OF THE INVENTION

[0007] An exercise device in accordance with the principles of the present invention provides for smooth natural action, exercises a relatively large number of muscles through a large range of elliptical motion, employs arm, shoulder and rotational movement, and provides for safety and stability. An exercise device in accordance with the principles of the present invention informs the user whether a proper amount of arm and shoulder force is being exerted.

[0008] An exercise device in accordance with the present invention includes a frame defining a longitudinal axis, with the frame having a rearward portion and a forward portion. A guide track and a foot link are provided. The foot link includes a rearward portion that is constrained to move in an orbital path approximately parallel to the longitudinal axis and a forward portion that reciprocally engages the guide track. A swing arm is provided having a pivotal connection to the frame. The swing arm includes an upper portion extending above the pivotal connection and a lower portion disposed below the pivotal connection. An engagement mechanism includes a first portion coupled to the lower portion of the swing arm and a second portion coupled to the forward portion of the foot link. A rearward force applied to the upper portion of the swing arm produces a force on the forward portion of the foot link having a downward component. A load monitoring mechanism is positioned to monitor the load applied to the swing arm.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same become better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

[0010] Figure 1 illustrates an elevated front perspective view of an exercise device in accordance with the principles of the present invention.

[0011] Figure 2 illustrates an elevated rear perspective view of the exercise device of Figure 1.

[0012] Figure 3 illustrates a side view of the exercise device of Figure 1.

[0013] Figure 4 illustrates a close-up perspective view of a portion of the exercise device of Figure 1, which includes the abutment arm and curved attachment link of the engagement assembly.

[0014] Figure 5 illustrates a close-up side view of the exercise device of Figure 1, which includes the abutment arm and curved attachment link of the engagement assembly.

[0015] Figure 6 illustrates a detailed side view of the connection between an upper body linkage and a lower body linkage of the exercise device of Figure 1.

[0016] Figure 7 illustrates a detailed front view of the connection between an upper body linkage and a lower body linkage of the exercise device of Figure 1.

[0017] Figure 8 illustrates a detailed, cut-away side view of one embodiment of the sensing means of the exercise device of Figure 1.

[0018] Figures 9 and 10 illustrate a further detailed, cut-away side view of the embodiment of the sensing means of Figure 8 depicting the applied forces.

[0019] Figure 11 is a schematic of a system for controlling and coordinating a desired workout level in accordance with the principles of the present invention.

[0020] Figure 12 illustrates an elevated front perspective view of an alternative exercise device in accordance with the principles of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0021] While an exemplary embodiment of the invention has been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention.

[0022] Figures 1-3 illustrate an embodiment of an exercise device 10 constructed in accordance with the principles of the present invention that exercises both the upper and lower body in associated motion. Briefly described, the exerciser 10 includes a frame 12 that has a forward upright member 20. The forward upright member 20 extends upwardly and curves slightly rearward from a substantially horizontal, longitudinal central member 14 of the frame 12. Left and right axle mounts 30, 32 extend upwardly towards the rear region of the frame 12. The axle mounts 30, 32 support a transverse axle 34 that is preferably operatively connected to a flywheel 36. The left and right ends of the transverse axle 34 rotatably engage left and right crank arm assemblies 40, 50. Left and right foot links 60, 70 each include a forward portion 62, 72, a rearward portion 64, 74, and a foot support portion 66, 76 there between. The rearward portions 64, 74 of the foot links 60, 70 engage the crank arm assemblies 40, 50 such that the foot support portion 66, 76 of the foot links travel in an arcuate reciprocal path as the transverse axle 34 rotates.

[0023] The forward portions 62, 72 of the foot links 60, 70 preferably are supported by rollers 68, 78, which engage guide tracks 42, 52 that are mounted to the frame 12. In one embodiment of the present invention, the guide tracks can be statically mounted to the frame 12. In an alternative embodiment, the guide tracks can incorporate a mechanism such as a motor (not shown) and a lead screw (not shown) for selectively adjusting the inclination of the guide tracks. The forward portions 62, 72 of the foot links 60, 70 are operatively connected to engagement assemblies 100, 110, which in turn are operatively connected to the coupling regions 86, 96 of left and right swing arm mechanisms 80, 90, respectively. The swing arm mechanisms 80, 90 are rotatably connected to the forward upright member 20 of the frame 12 at their respective pivot points 84, 94. The swing arm mechanisms 80, 90 further contain left and right hand-gripping portions 82, 92. Each engagement assembly 100, 110 includes an abutment arm 106, 116, and a curved attachment link 104, 114, which together prevent the derailment of the foot link rollers 68, 78 from the guide tracks 42, 52.

[0024] More particularly, the frame 12 includes the longitudinal central member 14 that terminates at forward and rearward portion portions 16, 18. Preferably, the forward portion 16 of the frame 12 simply terminates at the end of the longitudinal central member 14, while the rearward portion 18 terminates as a relatively shorter transverse member. Ideally, but not essentially, the frame 12 is composed of tubular members that are relatively light in weight but that provide substantial strength and rigidity. The frame 12 may also be composed of solid members that provide the requisite strength and rigidity while maintaining a relatively lightweight.

[0025] The forward upright member 20 extends upwardly and slightly rearward from the forward portion 16 of the floor-engaging frame 12. Preferably, the upright member 20 is slightly rearward curved; however, the forward member 20 may be configured at other upward angles without departing from the scope of the present invention. A relatively short, transversely oriented crossbar member 22 is connected to the forward upright member 20. Left and right balance arms 24, 26 depend downwardly from each end of the crossbar member 22 to engage the floor on each side of the longitudinal central member 14 near the forward portion of the exercise device 10, thereby increasing stability. Ideally, but not essentially, these members are composed of a material similar to that described above, and are formed in quasi-circular tubular configurations.

[0026] Preferably, a view screen 28 is securely connected to the upper portion of the forward upright member 20, at an orientation that is easily viewable to a user of the device 10. Instructions for operating the device as well as courses being traveled may be located on the view screen 24 in an exemplary embodiment. In some embodiments of the present invention, electronic devices may be incorporated into the exerciser device 10 such as timers, odometers, speedometers, heart rate indicators, energy expenditure recorders, controls, etc. This information may be routed to the view screen 28 for ease of viewing for a user of the device 10.

[0027] In the exemplary embodiment shown in Figure 3, the axle mounts 30, 32 are located toward the rearward portion 18 of the frame 12. The axle mounts 30, 32 are attached to the frame 12 and extend approximately upward from the substantially horizontal, longitudinal central member 14. The transverse axle 34 is rotatably housed in the upper region of the axle mounts 30, 32. These regions of the axle mounts 30, 32, which house the ends of the transverse axle 34, contain low friction engaging systems (not shown), such as bearing systems, to allow the transverse axle 34 to rotate with little resistance within the housing in the axle mounts 30, 32.

[0028] Referring again to the exemplary embodiment shown in Figure 3, the transverse axle 34 connects to a flywheel 36 contained within a center housing 38. Such flywheels are known in the art. However, in other embodiments, the transverse axle 34 may not incorporate a flywheel 36 and/or central housing 38, without departing from the scope of the present invention (provided that the foot links 60, 70 are coupled to one another in some fashion, albeit directly or indirectly). The transverse axle 34 may also be operatively connected to a capstan-type drive (not shown) in some embodiments, to allow the axle 34 to rotate in only one direction.

[0029] The elliptical motion exerciser 10 further contains longitudinally extending left and right foot links 60, 70. As shown in Figures 1-3, the foot links 60, 70 are illustrated in the shape of elongated, relatively thin beams. The foot links 60, 70 are aligned in approximately parallel relationship with the longitudinal central member 14 of the frame 12. The foot support portions 66, 76 are positioned near the forward portion of the foot links 60, 70, and provide stable foot placement locations for the user of the device. In some exemplary embodiments the foot support portions 66, 76 are configured to form toe straps and/or toe and heel cups (not shown) which aid in forward motion recovery at the portion of a rearward or forward striding motion of a user's foot.

[0030] Left and right crank arm assemblies 40, 50 couple the rearward portions 64, 74 of the foot links 60, 70 to the ends of the transverse axle 34. In one embodiment of the present invention shown in Figures 1-3, the crank arm assemblies 40, 50 are comprised of single left and right crank arm members. In this exemplary embodiment the proximal portions of the crank arm members 40, 50 engage the ends of the transverse axle 34, while the distal portions of the crank arm members 40, 50 are rotatably connected to the rearward portions 64, 74 of the foot links 60, 70. In this configuration, the rearward portions 64, 74 of the foot links 60, 70 orbit about the transverse axle 34 as the axle rotates, and the foot support portions 66, 76 of the foot links 60, 70 travel in a reciprocal, elliptical path of motion; however, the elliptical path of the foot support portions 66, 76, and indeed the motion of the entire foot links 60, 70 can be altered into any number of configurations by changing the composition or dimensions of the crank arm assemblies 40, 50. For example, the length of the single left and right crank arms shown in Figure 1 can be lengthened or shortened to modify the path of the foot links 60, 70. Further, the left and right crank arm assemblies 40, 50 can be composed of multiple crank arm member linkages to alter the path of travel of the foot links 60, 70 in a wide variety of aspects.

[0031] In an alternate embodiment of the present invention the rearward portions 64, 74 of the foot links 60, 70 are rotationally connected directly to a flywheel which functions to couple the foot links 60, 70 to a pivot axis (equivalent to the axis of the transverse axle 34) and permit rotation thereabout. In this embodiment, the flywheel is preferably a double flywheel that supports rotation about a central axis. Various mechanical arrangements may be employed to embody the crank arm assemblies 40, 50 in operatively connecting the foot links 60, 70 to each other. Such variations may include a larger flywheel, a smaller flywheel, or may eliminate the flywheel entirely and incorporate a cam system with connecting linkage, provided that the foot links are coupled so as to permit an arcuate path of travel by the foot support portions 66, 76 of the foot links 60, 70.

[0032] As most clearly shown in Figures 4-5, the exerciser device 10 further contains left and right guide tracks 42, 52. The guide tracks 42, 52 can be completely separate members, or can be part of one single connected unit (as shown in Figures 4 and 5). The guide tracks 42, 52 attach to the longitudinal central member 14 of the frame 12 at an angled inclination. In one embodiment, the angle of inclination is approximately 30 degrees. Preferably, the upper surface of the guide tracks 42, 52 is shaped to contain two longitudinally extending, adjacent engagement grooves 44, 54. These engagement grooves 44, 54 give the upper surface of the guide tracks 42, 52 a generally "W-shaped" cross-sectional configuration. The engagement grooves 44, 54 are specifically sized and shaped to correspondingly mate with the rollers 68, 78 of the foot links 60, 70 in order to assist in the lateral containment of the rollers 68, 78 on the guide tracks. In addition, the lower surface of the guide tracks 42, 52 preferably contain longitudinally extending stabilizing troughs 46, 56 (see Figure 4).

[0033] The left and right forward portions 62, 72 of the foot links 60, 70 terminate in left and right engagement rollers 68, 78. The left and right engagement rollers 68, 78 ride along the above-described grooves 44, 54 of the guide tracks 42, 52. Preferably, the engagement rollers 68, 78 are actually pairs of rollers. The engagement rollers 68, 78 rotate about axles that are affixed to the forward portions 62, 72 of the foot links 60, 70. During use of the exercise device 10, the engagement rollers 68, 78 at the front of the foot links 60, 70 translate back and forth the length of the guide tracks 42, 52 in rolling engagement within the grooves 44, 54, as the foot support portions 66, 76 of the foot links 60, 70 travel in an arcuate path of motion, and the rearward portions 64, 74 of the foot links 60, 70 rotate about the transverse axle 34. In an alternate embodiment of the present invention, the engagement rollers 68, 78 could be replaced with sliding engagement mechanisms without departing from the scope of the present invention.

[0034] As shown in Figures 4-5, left and right engagement assemblies 100, 110 operatively connect the forward portions 62, 72 of the foot links 60, 70 to the coupling regions 86, 96 of swing arm mechanisms 80, 90. Preferably, each of the engagement assemblies 100, 110 includes a curved attachment link 104, 114, and an abutment arm 106, 116. In alternate embodiments, either more or fewer members can be utilized to produce the engagement assemblies 100, 110 without departing from the scope of the present invention. In an exemplary embodiment, the abutment arms 106, 116 each have an abutment knob 108, 118. The abutment knobs 108, 118 are designed to withstand intermittent contact with the stabilizing troughs 46, 56 on the lower surface of the guide tracks 42, 52 during use of the exercise device 10.

[0035] In alternate embodiments of the present invention, the engagement assemblies 100, 110 could be configured such that the abutment knobs 108, 118 were located on the curved attachment links 104, 114 (or the abutment knobs could be deleted altogether), without departing from the scope of the present invention. Further, depending on the exact configuration and number of links utilized in the engagement assemblies 100, 110, the curved attachment links 104, 114 may not even be curved, but rather may be linear attachment links. Each curved attachment link 104, 114 is rotatably coupled to an abutment arm 106, 116. Each curved attachment link 104, 114 is fixedly secured to the forward portion 62, 72 of a foot link 60, 70, and each abutment arm 106, 116 is rotatably coupled to the coupling region 86, 96 of a swing arm mechanism 80, 90.

[0036] Referring again to Figures 1-3, the exerciser device 10 contains left and right swing arm mechanisms 80, 90. Respectively, each swing arm mechanism 80, 90 contains a hand-gripping portion 82, 92, a pivot point 84, 94, and a coupling region 86, 96. The coupling regions 86, 96 of the swing arm mechanisms 80, 90 rotatably connect to the engagement assemblies 100, 110, and in turn to the foot support portions 66, 76 of the foot links 60, 70. The pivot points 84, 94 rotatably secure the swing arm mechanisms 80, 90 to each end of the crossbar member 22 of the frame 12. The coupling regions 86, 96 of the swing arm mechanisms 80, 90 are described in more detail below with respect to Figures 6-10.

[0037] The hand-gripping portions 82, 92 of the swing arm mechanisms 80, 90 are grasped by the hands of the individual user, and allow upper body arm and shoulder exercising motions to be incorporated in conjunction with the reciprocal, elliptical exercising motion traced out by the user's feet. As can be more readily understood with reference to Figures 1-3, the linking of the swing arm mechanisms 80, 90 to the foot links 60, 70, via the engagement assemblies 100, 110, and the rotational securing of the swing arm mechanisms 80, 90 to the forward upright member 20 of the frame 12 at the pivot points 84, 94, results in generally rearward, arcuate motion of a hand-gripping portion being correspondingly linked to a generally forward, arcuate motion of a respective foot support portion, and vice versa.

[0038] An alternative exemplary exercise device that can incorporate the principles of the present invention is set forth in Figure 12. The exercise device includes a frame 712 having a pivot axis, X, defined therein, as for example by a shaft passing through, and supported by the frame 712. In this exemplary embodiment, the shaft has a flywheel 718 supported thereupon for rotation about the pivot axis X. The exercise device further includes a first and second bell crank 720, 722 pivotally mounted for rotation about the axis X. First and second foot links, 724, 726 are provided. The foot links 724, 726 are generally elongated members having a first portion pivotally connected to the bell cranks 722, 720 in such a manner so as to permit travel of the first portions of the foot links 724 and 726 in an arcuate path of travel about the pivot axis X at a predetermined length corresponding to the length of the bell cranks 720, 722.

[0039] A pair of arm links 764 and 766 are provided. Each arm link 764, 766 is pivotally supported by the frame 712 at support point 768. The arm links 764, 766 are also pivotally coupled to the ends 724", 726" of the foot links 724, 726. As indicated by phantom line Y, pivoting of the arm links 764, 766 about the support point 768 causes the second ends 724", 726" of the foot links 724, 726 to reciprocate along the curved path Y. The arm links 764, 766 also include handle portions 764a, 766a associated therewith. These handle portions may be configured to be gripped by a user and, during the operation of the device they also reciprocate, thereby providing upper body exercise.

[0040] In an exercise device such as the present invention, where the swing arm mechanisms are operatively associated with the foot links, there is a tendency for the user to exert little or no force on the upper body linkages (upper portions of the swing arm mechanisms 80 and 90 or the arm links 764 and 766). This is because the upper body linkages travel through a given path regardless of whether the user is exerting any force on the arm due to the force being exerted on the lower body linkages. In many instances, this occurs inadvertently. The opposite drawback can also occur where too much force is exerted on the upper body linkages, thereby diminishing the amount of force exerted on the lower body linkages.

[0041] An exercise device that is constructed in accordance with the present invention addresses these concerns and results in a device that effectively informs the user whether a proper or desired amount of arm and shoulder force is being exerted. Referring to Figures 6-10, detailed views of the connection (or coupling) between an upper body linkage (swing arm mechanism 90) and a lower body linkage (foot link 70 through attachment link 114 and abutment arm 116) of the exercise device of the present invention is seen. The linkage includes a load monitoring mechanism 122 that is capable of measuring the load being exerted on at least one of the swing arm mechanisms 80, 90. In one embodiment, the load monitoring mechanism 122 comprises a flexible member 124 having a motion sensor 126 monitoring the movement caused by the load exerted by the user on at least one of the swing arm mechanisms 80, 90. The flexible member 124 can be made of high flex plastic material such as, for example, an acetal-type plastic material. Alternatively, spring steel or any conventional spring-type material or any material that is stiff enough to support the connection, but still can flex under load can be utilized. By calibrating the movement or deflection of the flexible member 124 to measured loads on the swing arm mechanism 80, 90, the movement or deflection of the flexible member 124 can be translated into the load being exerted on the swing arm mechanism 80, 90.

[0042] In one embodiment, the motion sensor 126 is a Sensopad™ system available from Sensopad Technologies, Ltd. of Cambridge, U.K. and the subject of UK Patent Application No. GB 2374424 filed on 31 July 2002. The Sensopad™ system is a contactless position sensing technology in which a Sensopad™ pad detects the position and identity of a Sensopad™ puck 128 (best seen in Figures 8-10). The Sensopad™ puck 128 is made of an inductor and a capacitor that make up a resonant LC electronic circuit imbedded into the flexible member 124. The Sensopad™ pad 130 includes drive and receive coils and has transmit and receive signals. The pad 130 senses the puck 128 and the geometry of the pad 130 determines the sensing directions of the system. The Sensopad™ electronics send the signal to the pad, for example by an electric wire 132, which interrogate the puck 128 and monitors the signals coming back from the pad 128, turning these signals into data that is sent to the exercise device microprocessor by an electronic connection. This electronic connection can be via wires or alternatively, by a wireless date transmitter.

[0043] In operation, the transmit circuit is driven with an alternative current provided by Sensopad™ electronics. This generates an alternative electromagnetic field in the space above and below the pad. If the frequency is close to the resonant frequency of the puck, then the puck couples energy from the drive and resonates. The puck re-emits this energy, due to the inherent loss in the resonant circuit, producing its own alternative electromagnetic field at the same frequency, which the receive circuit picks up. From this, the electronics calculates the identity and position of the puck.

[0044] In alternative embodiments, different types of force transducers can be utilized to measure loads on the swing arm mechanism. For example, a load cell can be utilized pursuant to which member 124 can be rigid. Load cells convert force or weight into an electrical signal. The load cell includes a strain gage. The strain gage changes resistance when it is stressed. The gages can be made of an ultra-thin heat-treated metallic foil that is chemically bonded to a thin dielectric layer. "Gage patches" are then mounted to the strain element with specially formulated adhesives. Each gage patch consists of one or more fine wires cemented to the surface of a beam, ring, or column (the strain element) within the load cell. As the surface to which the gage is attached becomes strained, the wires stretch or compress changing their resistance proportional to the applied load. One or more strain gages are used in the making of a load cell. Multiple strain gages are connected to create the four legs of a Wheatstone-bridge electronic circuit configuration. When an input voltage is applied to the Wheatstone-bridge, the output becomes a voltage proportional to the force on the cell. This output can be amplified and processed by the exercise device microprocessor. Of course, other components capable of detecting movement, deflections and/or loads can alternatively be utilized. By way of further example, Hall-effect sensors based on Hall-effect technology could be utilized.

[0045] In additional embodiments, still further position sensing technologies (in addition to the Sensopad™ system and a load cell) can be used in a flexible beam design. For example, optical sensors (reflective or transmissive), magnetostrictive sensors, hall effect (magnetic field) sensors, capacitive sensors or simple potentiometer/resistive sensors can be used. In addition, the flexible beam and displacement sensor can be replaced with either a strain- gauge or piezoelectric load cell. The principles of the present invention therefore apply to any means that can be used for monitoring the force applied by the upper body.

[0046] By measuring the load in the upper body linkage, the exercise device can display a percentage of effort or of relative effort being put out by the user on the upper body verses the lower body. The exercise device can also inform the user if the user is pushing only, pulling only or the effort variations between push and pull efforts. By utilizing this information, the exercise device can provide feedback to the user by displaying upper body involvement levels, provide interval training for the upper body, and encourage the user to increase or decrease the upper body involvement to ensure efficient and safe use of the exercise device. In addition, utilizing the principles of the present invention the ratio of load being exerted on the upper body with respect to the lower body can be determined and displayed to the user. This information can be routed to the view screen 28 for ease of viewing for a user of the device 10.

[0047] A system is provided for controlling the exercise equipment electronics is provided. In one embodiment, the system for controlling and coordinating the angle of inclination of the guide tracks 42, 52, the resistance applied to the rotation of the flywheels 24 to achieve a desired workout level, and for monitoring and measuring the load in the upper body linkage (swing arm mechanisms 80 and 90) is illustrated schematically in Figure 11. A physical workout parameter, e.g., user's heart rate, is monitored by a sensor 186. An electrical signal, typically analog in nature, related to the user's heart rate is generated. Various types of heart rate monitors are available, including chest worn monitors, ear lobe monitors and finger monitors. The output from the monitor 186 is routed through an analog to digital interface 188, through controller 190 and to a central processing unit (CPU) 192, ideally located within display panel 28. In addition to, or in lieu of, the user's heart rate, other physical parameters of the exerciser may be utilized, including respiratory rate, age, weight, sex, etc.

[0048] The exercise control system of the present invention includes an alternating current power inlet 194 connectable to a standard amperage AC 110 volt power supply. The power inlet 194 is routed to a transformer 196 and then on to the brake system 40 and the display panel 74. Typically, the height adjustment mechanism utilizes AC power, and thus, is not connected to the transformer 196. The height adjustment mechanism can include a sensing system 147 to sense the angle of inclination of the guide tracks 42, 52. This information is routed through the analog to digital interface 188, through controller 190 and to the CPU 192. The rotational speeds of each of the flywheels can also be monitored by sensors 180, with this information is transmitted to the CPU through the analog to digital interface 188 and controller 190. The load in the upper body linkage is monitored and measured by load monitoring mechanism including the sensor 124, with this information transmitted to the CPU through the analog to digital interface 188 and controller 190. Thus, during use the CPU can be apprised of the heart rate or other physical parameter of the exerciser being sensed by sensor 186, the angle of inclination of the guide tracks 42, 52, the speeds of the flywheels, and the load in the upper body linkage. This information, and/or related information, may be displayed to the exerciser through display 28.

[0049] In addition, various information can be loaded into and utilized by the CPU in conjunction with the load in the upper body linkage. For example, one area of error in measuring the upper body loads could occur from an inertial load caused by the leg movement. In one embodiment, the inertial load on the upper body linkages can be measured at the factory at various revolutions per minute (RPMs) to ascertain what the inertial load on the upper body linkages is at various speeds. This data can be loaded into and utilized by the CPU to cancel out any initial effect on the readings on the upper body linkage during usage. By way of additional example, data regarding the weight of the arms of individuals based on user weight, sex, height, etc. can be stored in the CPU and utilized by the CPU to more accurately determine the load on the upper body linkage during usage.

[0050] Further, through the present invention, a desired workout level may be maintained through the control system. For instance, certain parameters may be inputted through the keypad 80 by the exerciser, such as age, height, and sex, to achieve a desired heart rate range during exercise. Alternatively, the desired heart rate range may be directly entered by the exerciser. Other parameters may or may not be inputted by the exerciser, such as the desired speed of the flywheel corresponding to cycles per minute of the foot links and/or inclination of the guide tracks 42, 52. With this information, the control system of the present invention can adjust the braking systems and/or the height adjustment mechanism to achieve the desired workout level.

[0051] It is to be understood that various courses or workout regimes may be preprogrammed into the CPU 192 or designed by the user to reflect various parameters, including a desired cardiovascular range, type of stepping action, etc. The control system thereupon will control the brake system as well as the height adjustment mechanism to correspond to the desired workout regime.

[0052] To use the present device, the user stands on the foot support portions 66, 76 and grasps the hand-gripping portions 82, 92. The user imparts a forward stepping motion on one of the foot support portion, thereby causing the transverse axle 34 to rotate in a clockwise direction (when viewed from the right side as shown in Figure 1), due to the crank arm assemblies 40, 50 coupling the motion of the foot links 60, 70 to the rotation of the transverse axle 34. In conjunction with the lower body action, the user also imparts a substantially forward pushing motion on one of the hand-gripping portions and a substantially rearward pulling motion on the other hand-gripping portion. Due to the rotatable connection of the coupling regions 86, 96 of the swing arm mechanisms 80, 90 to the forward portions 62, 72 of the foot links 60, 70 (via the engagement assemblies), and the rotational securing of the swing arm mechanisms 80, 90 to the forward upright member 20 of the frame 12 at their pivot points 84, 94, each hand-gripping portion moves forward as its respective foot support portion moves rearward, and vice versa.

[0053] The foot links 60, 70 are attached to the transverse axle 34 by the crank arm assemblies 40, 50 such that one foot support portion moves substantially forward as the other foot support portion moves substantially rearward. In this same fashion one hand-gripping portion moves forward as the other hand-gripping portion moves rearward (e.g., when the left hand-gripping portion 82 moves forward, the left foot support portion 66 moves rearward, while the right foot support portion 76 moves forward and the right hand-gripping portion 92 moves rearward). Therefore, the user can begin movement of the entire foot link and swing arm mechanism linkage by moving any foot support portion or hand-gripping portion, or preferably by moving all of them together.

[0054] While the invention has been described with specific embodiments, other alternatives, modifications and variations will be apparent to those skilled in the art. For example, while the exemplary embodiment described herein places the load monitoring mechanism at the junction of the connection between an upper body linkage and a lower body linkage such load monitoring could occur at different locations. Accordingly, it will be intended to include all such alternatives, modifications and variations set forth within the spirit and scope of the appended claims.

Claims

1. An elliptical exercise device, comprising:

a frame;
a foot link having a rearward portion that is constrained to move in an orbital path and a forward portion;
a swing arm having a pivotal connection to the frame, the swing arm having an upper portion extending above the pivotal connection and a lower portion disposed below the pivotal connection;
an engagement mechanism having a first portion coupled to the lower portion of the swing arm and a second portion coupled to the forward portion of the foot link, such that a force applied to the upper portion of the swing arm will produce a force on the forward portion of the foot link; and
a monitoring mechanism positioned to monitor the load applied to the swing arm by a user.

2. The elliptical exercise device of claim 1, wherein the monitoring mechanism is positioned at the junction of the elongate swing arm and the foot link.

3. The elliptical exercise device of claim 1, wherein the monitoring mechanism comprises contactless position sensing technology.

4. The elliptical exercise device of claim 1, wherein the monitoring mechanism comprises a load cell.

5. The elliptical exercise device of claim 1, wherein the engagement mechanism comprises a flexible member and the monitoring mechanism is positioned to monitor the deflections on the flexible member.

6. The elliptical exercise device of claim 1, wherein the engagement mechanism comprises a rigid member and the monitoring mechanism is positioned to monitor the load on the rigid member.

7. The elliptical exercise device of claim 1, further including a left swing arm and right swing arm, a left foot link and right foot link, a left engagement mechanism and right engagement mechanism, and a left monitoring device and a right monitoring device.

8. The elliptical exercise device of claim 1 further including a guide track, wherein the foot link includes at least one roller, and the guide track has an upper surface that is adapted to rollably receive the foot link roller and that reciprocally engages the guide track.

9. The elliptical exercise device of claim 8, wherein the guide track includes an elevated forward portion.

10. The elliptical exercise device of claim 8, wherein the swing arm lower portion is disposed lower than the elevated forward portion of the guide track.

11. The elliptical exercise device of claim 8, wherein the guide tracks are mounted at an angled of inclination from horizontal.

12. The elliptical exercise device of claim 1, further including a frame comprising a longitudinal member, an upright member extending upwardly from the longitudinal member and a transverse member extending outwardly transversely from the upright member and wherein the swing arm is pivotally connected to opposite portions of the transverse member.

13. The elliptical exercise device of claim 12, wherein the frame further comprises a plurality of balance arms depending downwardly from the transverse member to provide support for the elliptical exercise device.

14. The elliptical exercise device of claim 12 further comprising an electronic view screen attached to the upright member for displaying exercise information.

15. The elliptical exercise device of claim 14 further wherein information from the load monitoring mechanism is displayed on the electronic view screen.

16. The elliptical exercise device of claim 1, further comprising a rearwardly disposed flywheel, wherein the foot link is rotationally coupled to the flywheel with a crank arm assembly.

17. The elliptical exercise device of claim 1 further wherein inherent inertial loads of the machine are calculated and then subtracted from load measured at the arm link to more accurately monitor the load being applied by the user.

18. An elliptical exercise device, comprising:

a frame;
a foot link;
a swing arm having a pivotal connection to the frame, the swing arm having an upper portion extending above the pivotal connection and a lower portion disposed below the pivotal connection;
an engagement mechanism having a first portion coupled to the lower portion of the swing arm and a second portion coupled to the foot link;
a monitoring mechanism positioned to monitor the load applied to the swing arm; and
an electronic view screen attached to the frame for displaying exercise information, including information from the monitoring mechanism.

19. The elliptical exercise device of claim 18, wherein the monitoring mechanism is positioned at the junction of the elongate swing arm and the foot link.

20. The elliptical exercise device of claim 18, wherein the monitoring mechanism comprises contactless position sensing technology.

21. The elliptical exercise device of claim 18, wherein the monitoring mechanism comprises a load cell.

22. The elliptical exercise device of claim 18, wherein the engagement mechanism comprises a flexible member and the monitoring mechanism is positioned to monitor the deflections on the flexible member.

23. The elliptical exercise device of claim 18, wherein the engagement mechanism comprises a rigid member and the monitoring mechanism is positioned to monitor the load on the rigid member.

24. The elliptical exercise device of claim 18, wherein the foot link includes a rearward portion that is constrained to move in an orbital path.

25. The elliptical exercise device of claim 18, further including a left swing arm and right swing arm, a left foot link and right foot link, a left engagement mechanism and right engagement mechanism, and a left load monitoring device and a right load monitoring device.

26. The elliptical exercise device of claim 18, further including a guide track, wherein the foot link includes at least one roller, and the guide track has an upper surface that is adapted to rollably receive the foot link roller and that reciprocally engages the guide track.

27. The elliptical exercise device of claim 25, wherein the guide track includes an elevated forward portion.

28. The elliptical exercise device of claim 25, wherein the swing arm lower portion is disposed lower than the elevated forward portion of the guide track.

29. The elliptical exercise device of claim 25, wherein the guide tracks are mounted at an angled of inclination from horizontal.

30. The elliptical exercise device of claim 18, further including a frame comprising a longitudinal member, an upright member extending upwardly from the longitudinal member and a transverse member extending outwardly transversely from the upright member and wherein the swing arm is pivotally connected to opposite portions of the transverse member.

31. The elliptical exercise device of claim 29, wherein the frame further comprises a plurality of balance arms depending downwardly from the transverse member to provide support for the elliptical exercise device.

32. The elliptical exercise device of claim 18, further comprising a rearwardly disposed flywheel, wherein the foot link is rotationally coupled to the flywheel with a crank arm assembly.

33. The elliptical exercise device of claim 18, further wherein a processor cancels out an inertial load caused by the leg movement.

34. The elliptical exercise device of claim 18 further wherein inherent inertial loads of the machine are calculated and then subtracted from load measured at the arm link to more accurately monitor the load being applied by the user.

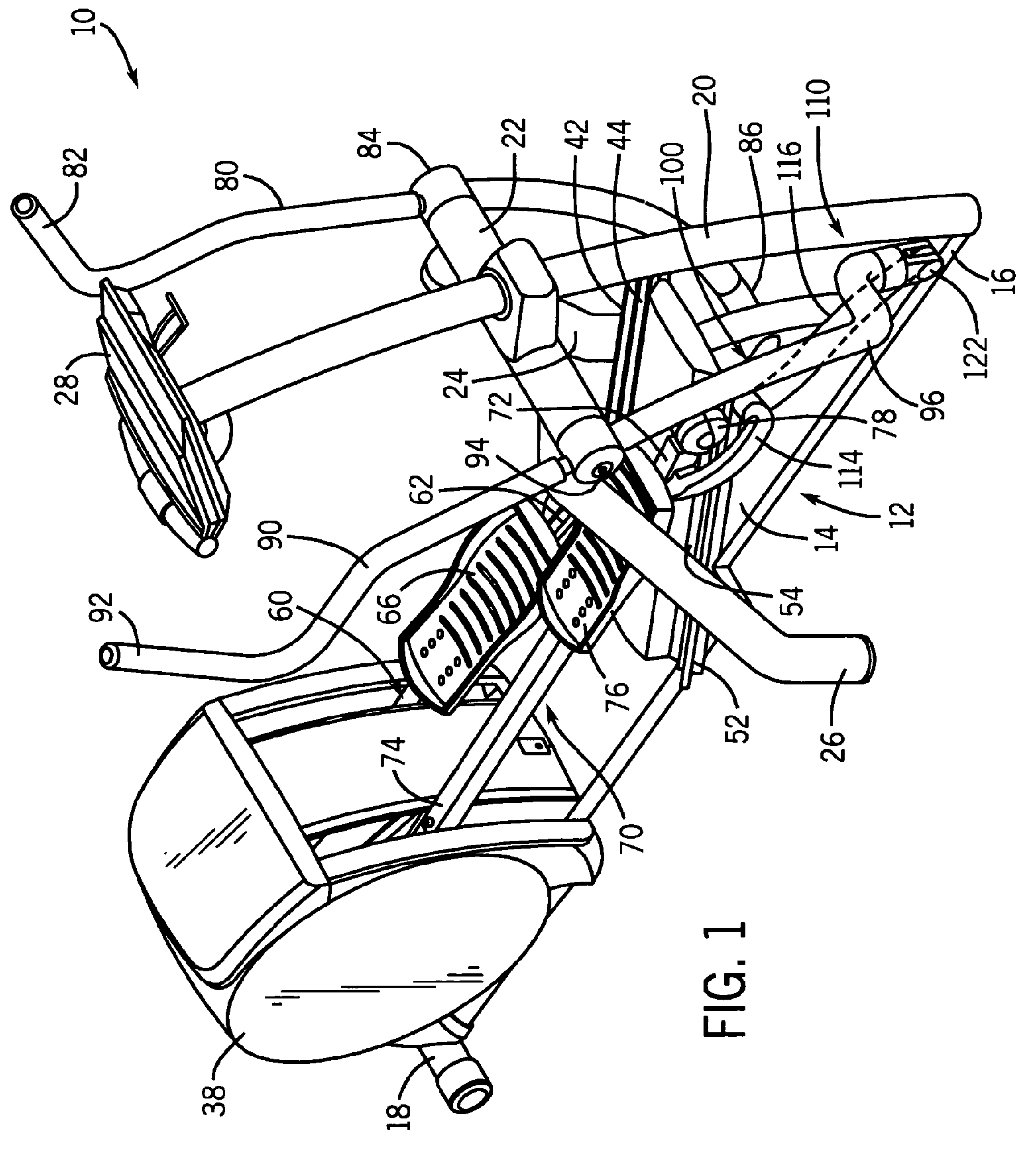
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FIG. 1

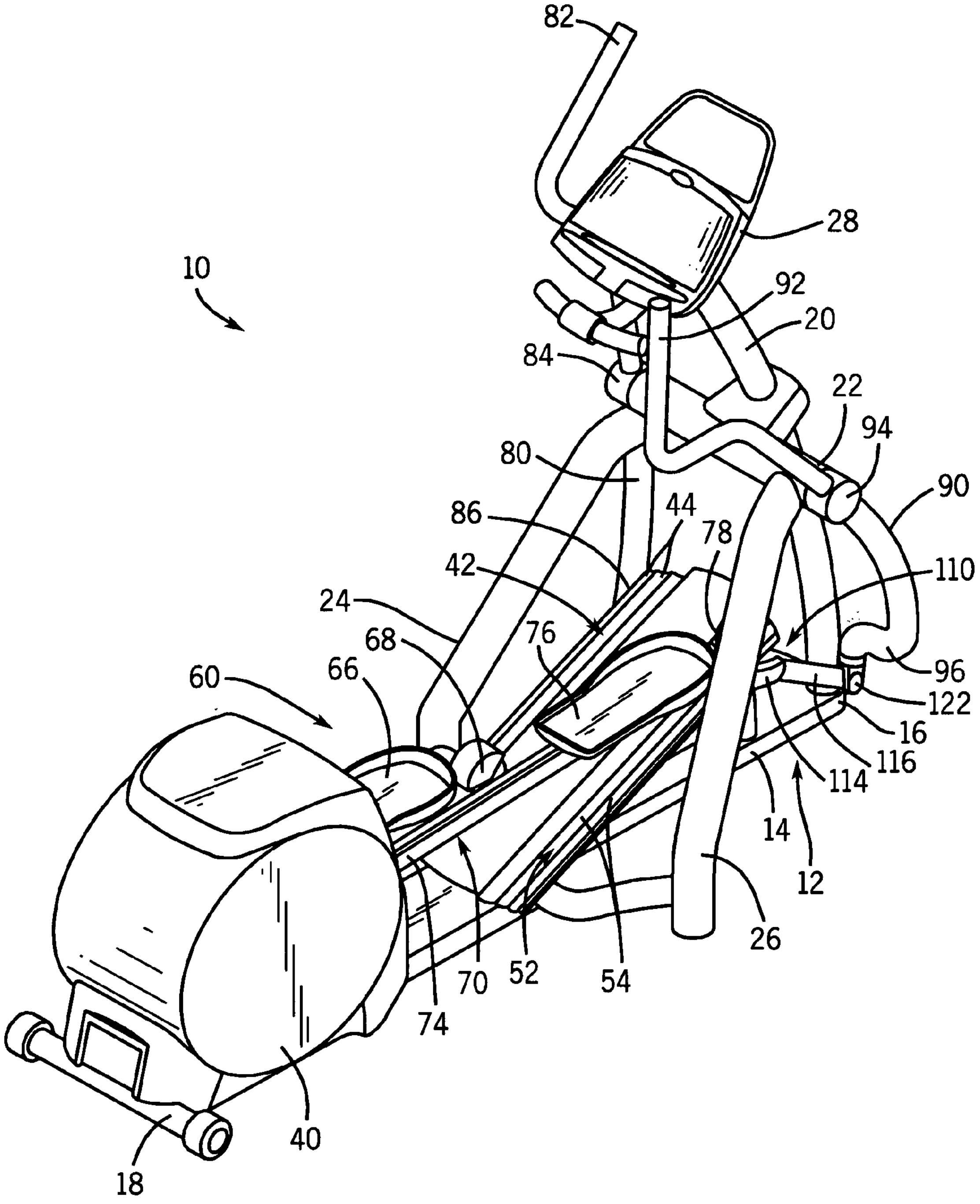
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FIG. 2

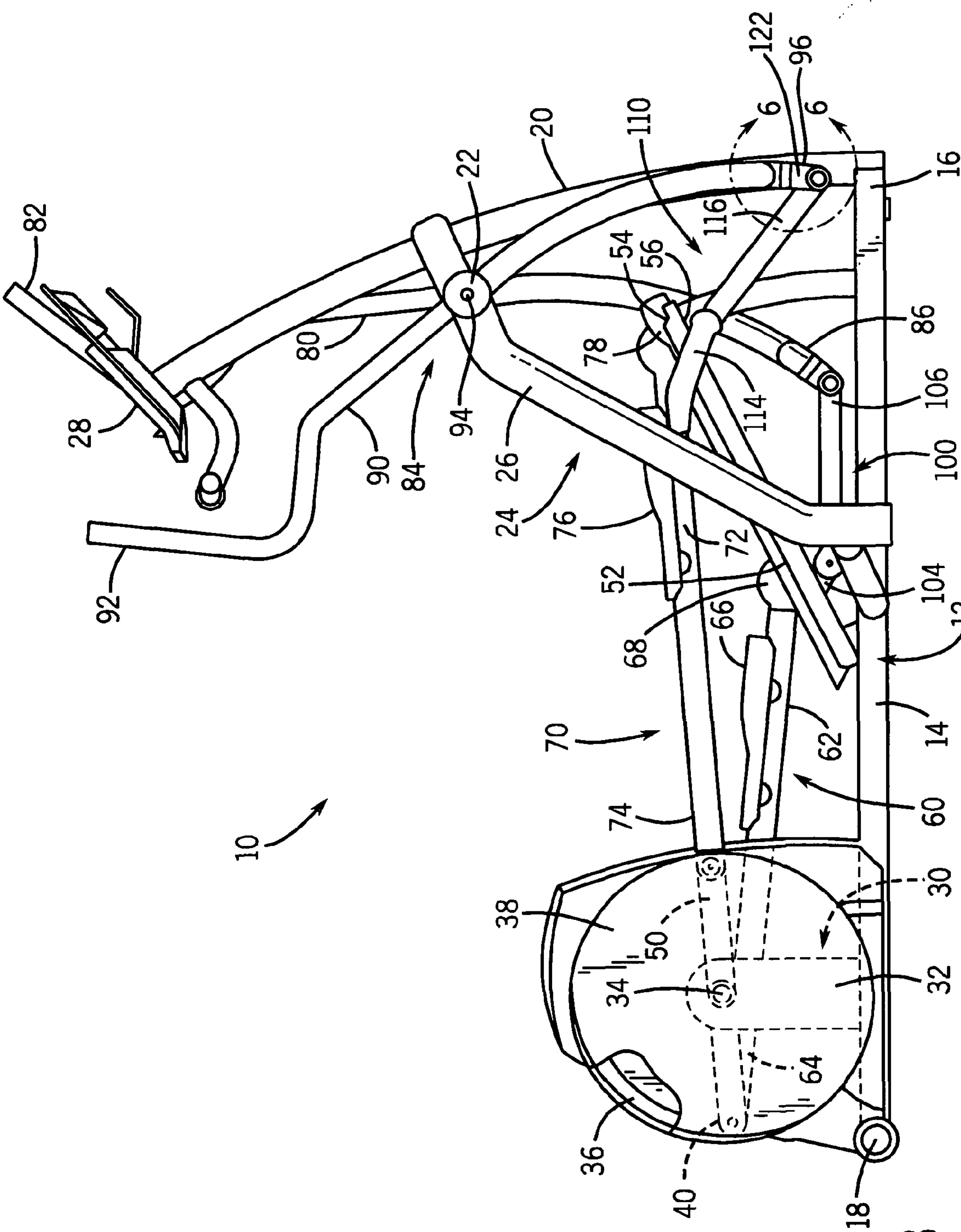
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FIG. 3

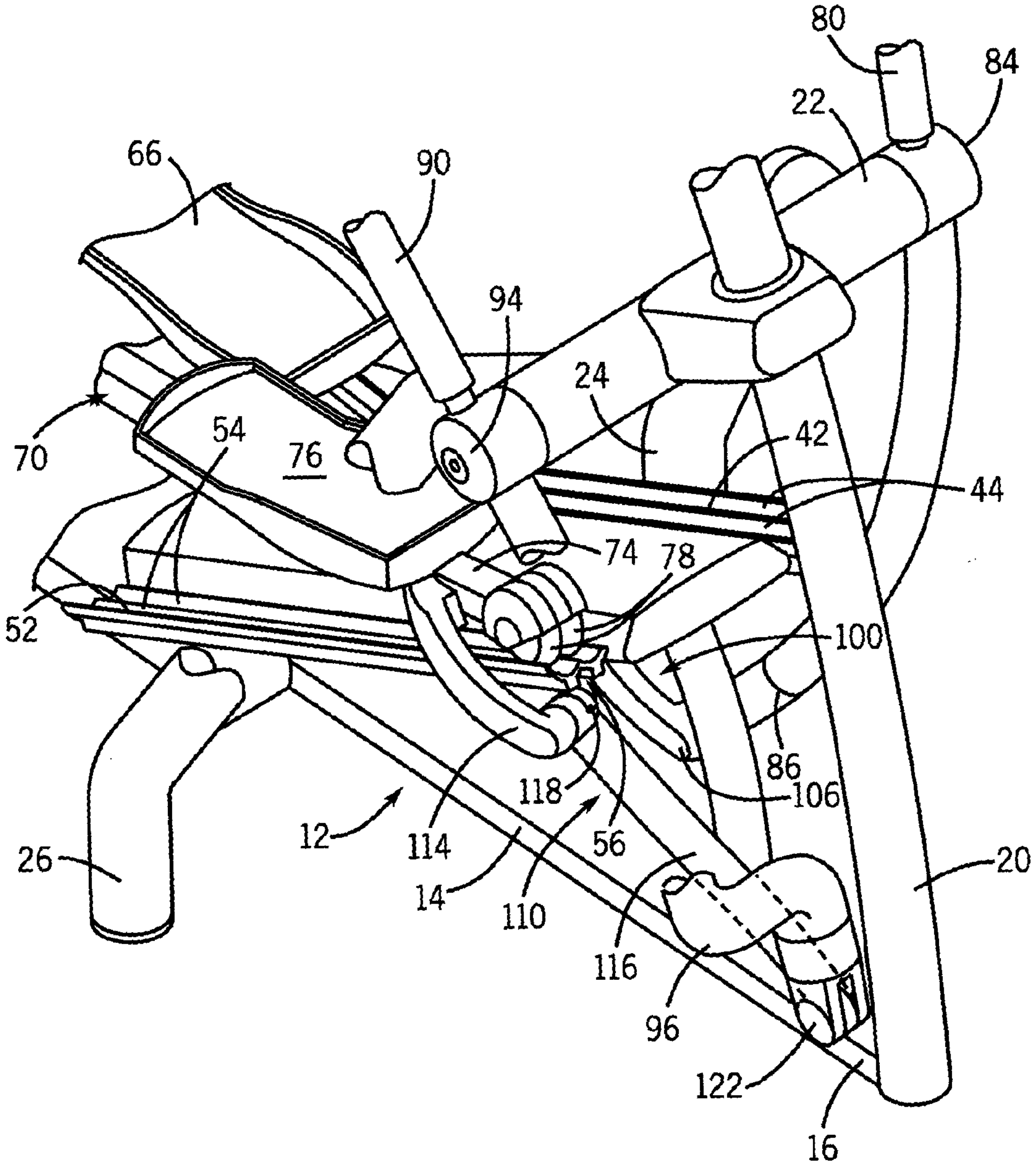
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FIG. 4

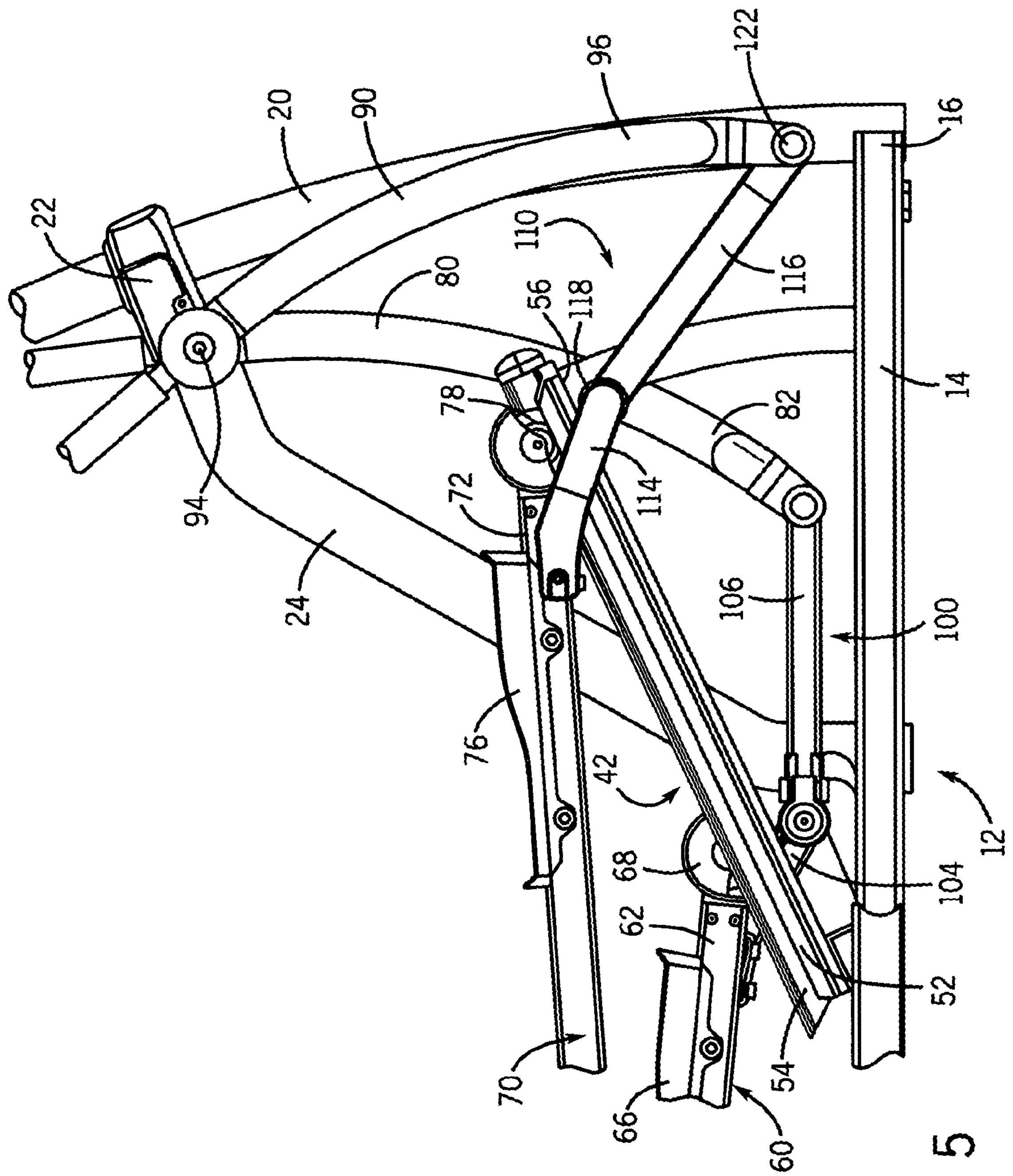
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FIG. 5

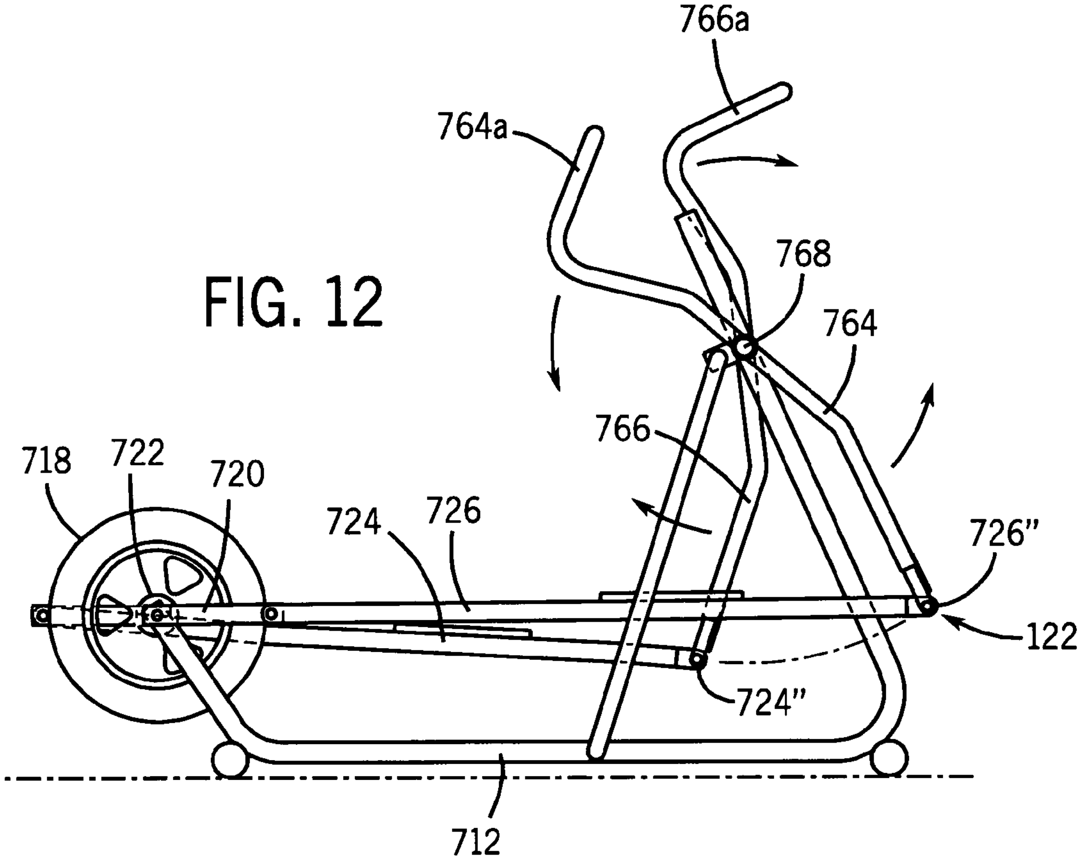


FIG. 12

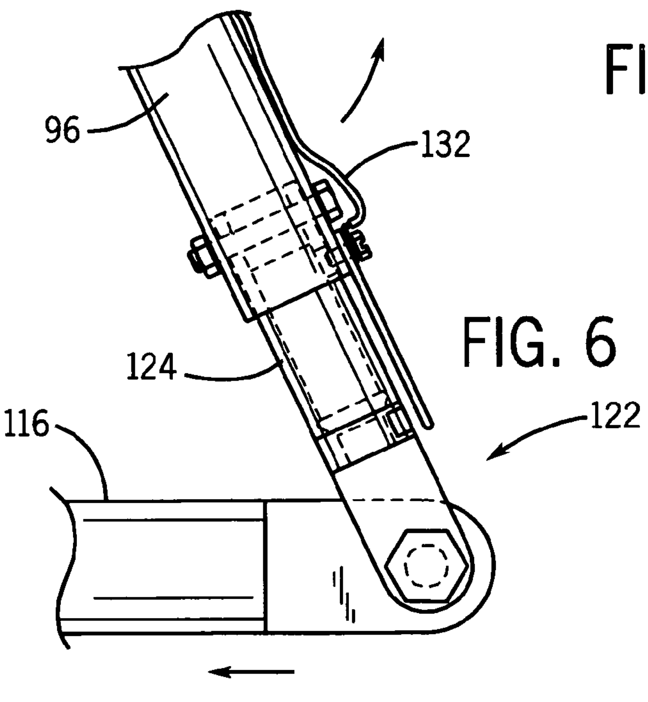


FIG. 6

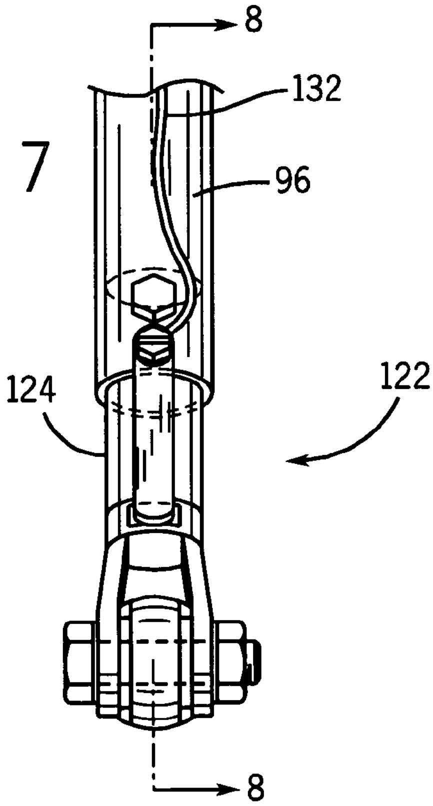


FIG. 7

FIG. 8

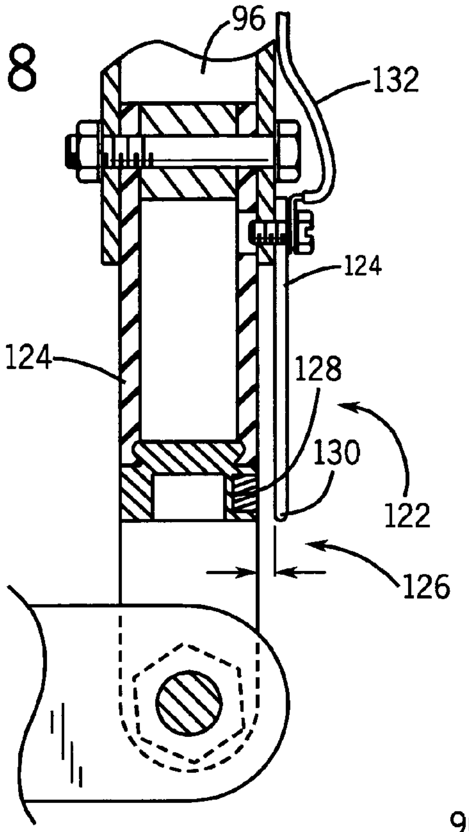


FIG. 9

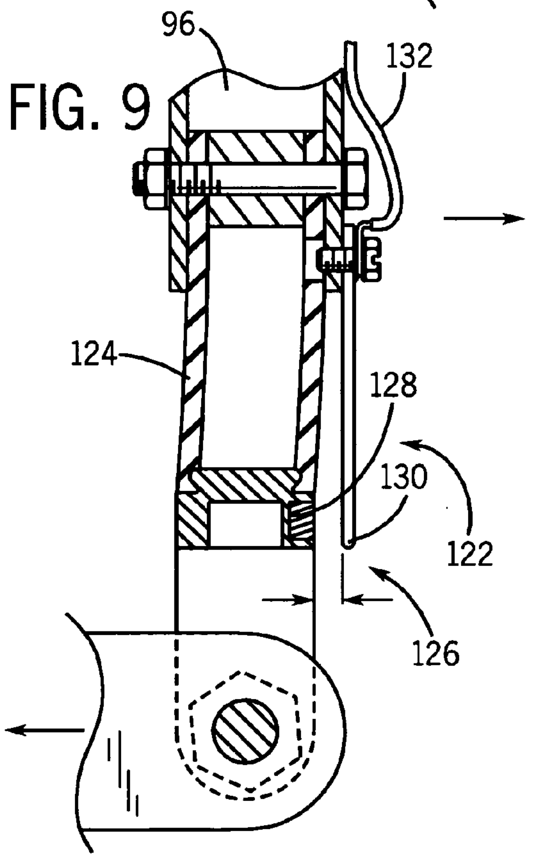
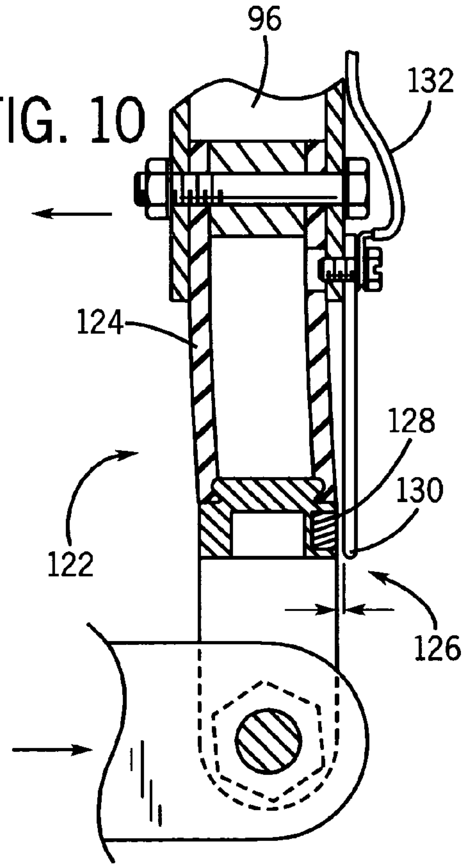
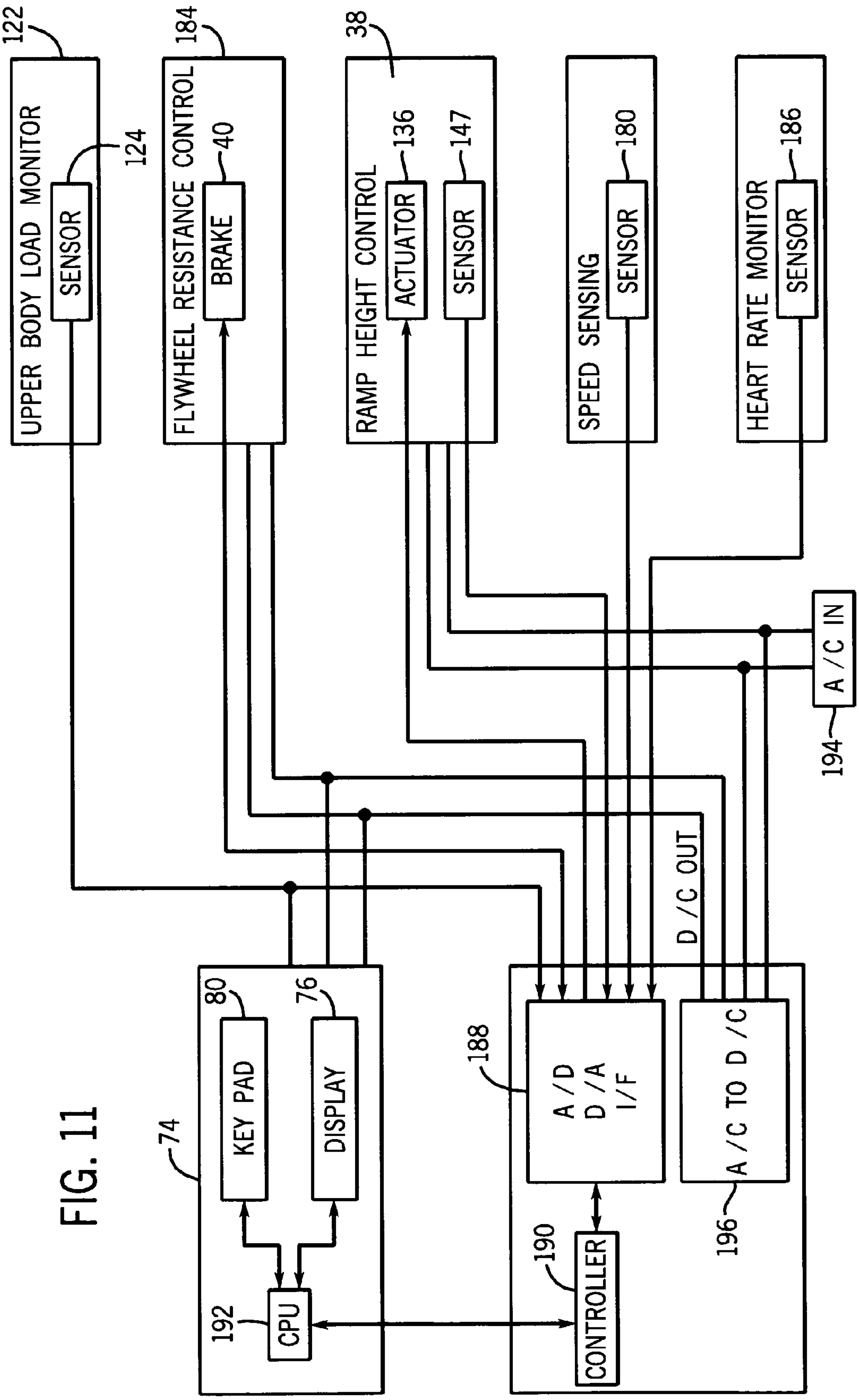


FIG. 10

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RAMP HEIGHT CONTROL
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38
136
147
SPEED SENSING
SENSOR
180
HEART RATE MONITOR
SENSOR
186
A /C IN
194
D /C OUT
KEY PAD
DISPLAY
CPU
80
76
74
192
A / D
D / A
I/F
188
A /C TO D /C
196
CONTROLLER
190

FIG. 11