Sept. 16, 1969 D. A. JUSTICE 3,467,373

CENTRIFUGAL EXERCISER

Filed Dec. 17, 1965 4 Sheets-Sheet 1

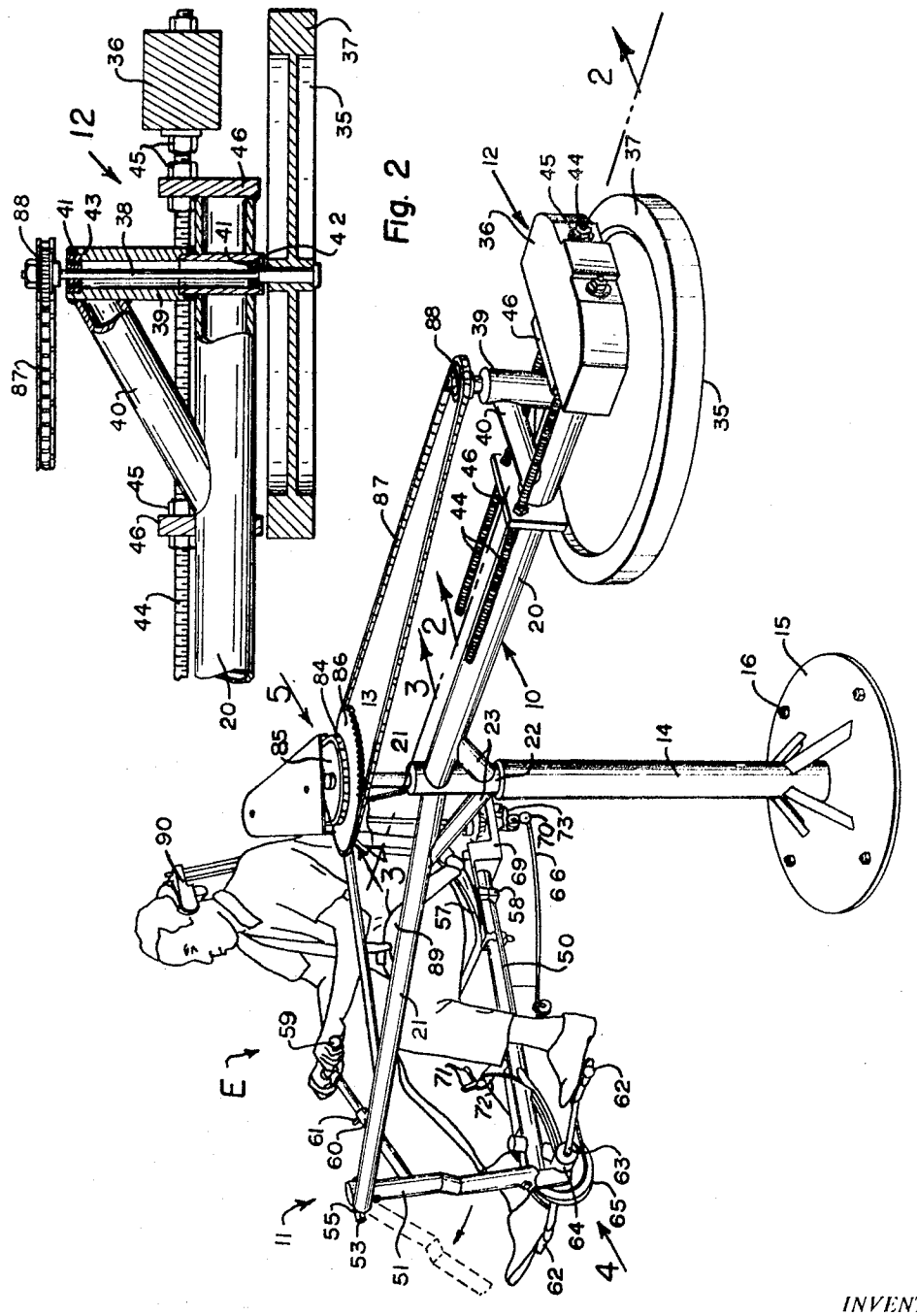


Fig. 1

Fig. 2

INVENTOR.
Donald A. Justice
BY Van Valkenburgh & Lowe

ATTORNEYS

Sept. 16, 1969 D. A. JUSTICE 3,467,373

CENTRIFUGAL EXERCISER

Filed Dec. 17, 1965 4 Sheets-Sheet 2

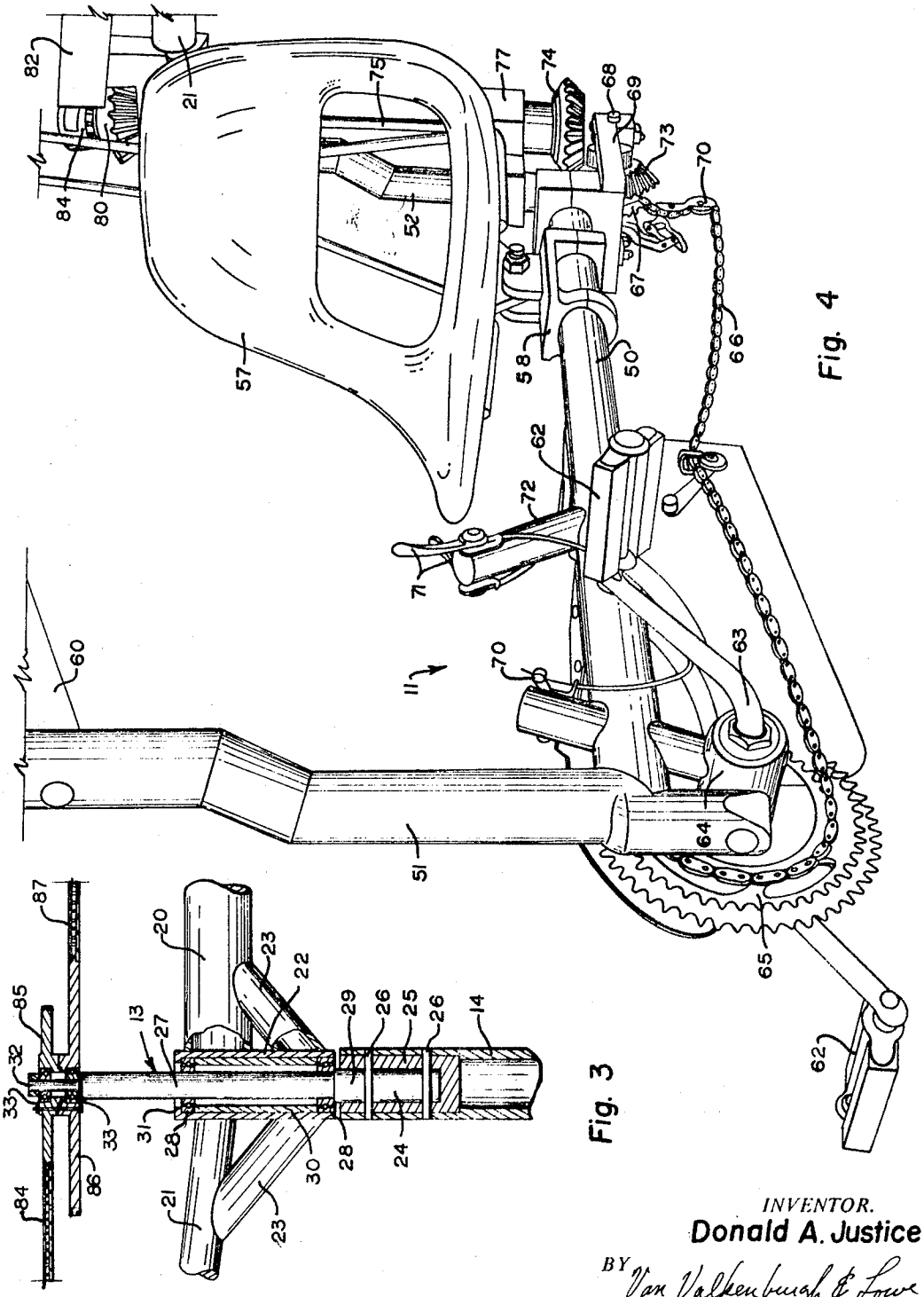


Fig. 4

Fig. 3

INVENTOR.
Donald A. Justice
BY Van Valkenburgh & Lowe
ATTORNEYS

Sept. 16, 1969 D. A. JUSTICE 3,467,373

CENTRIFUGAL EXERCISER

Filed Dec. 17, 1965 4 Sheets-Sheet 3

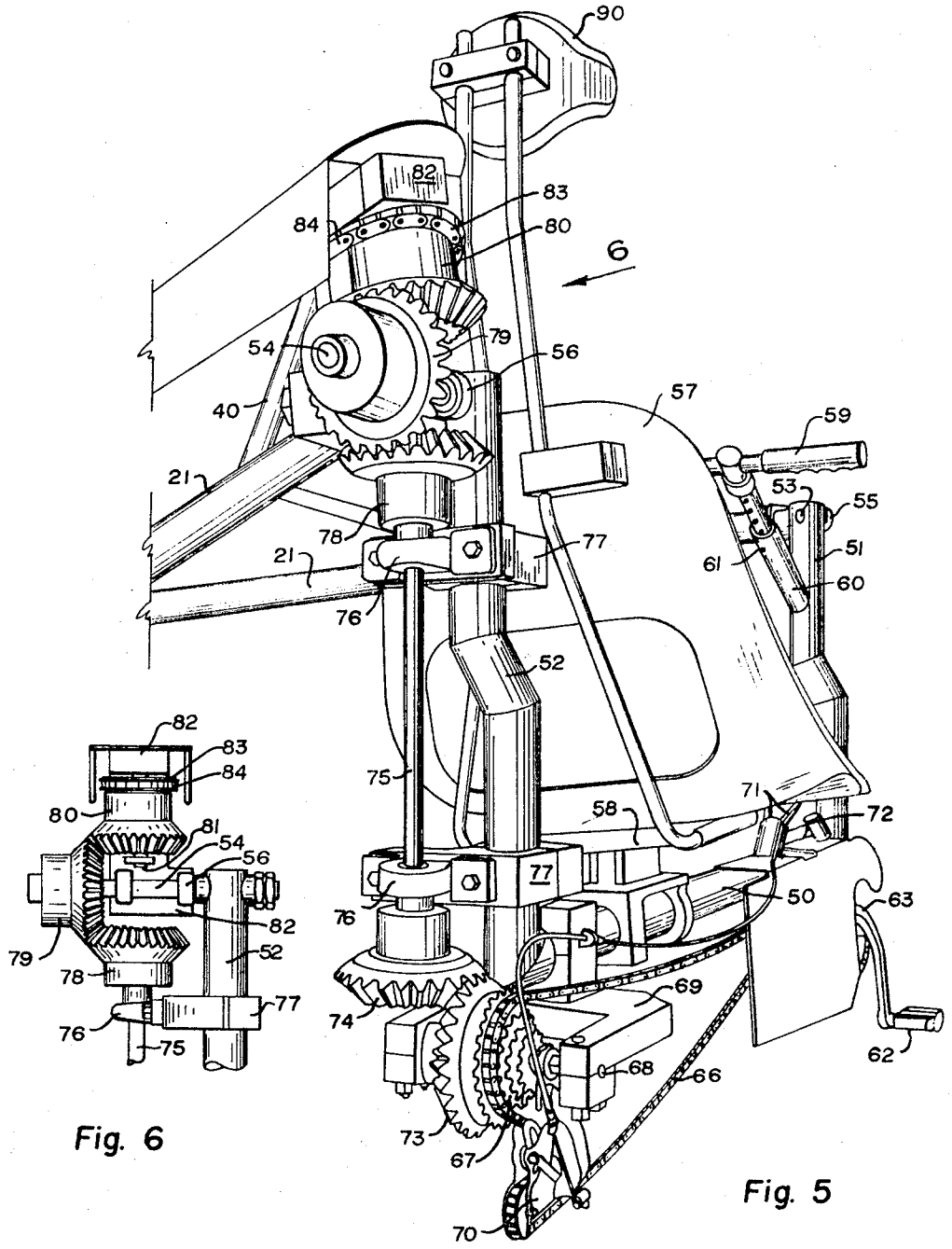


Fig. 5

Fig. 6

INVENTOR.
Donald A. Justice

BY Van Valkenburgh & Lowe

ATTORNEYS

Sept. 16, 1969 D. A. JUSTICE 3,467,373

CENTRIFUGAL EXERCISER

Filed Dec. 17, 1965 4 Sheets-Sheet 4

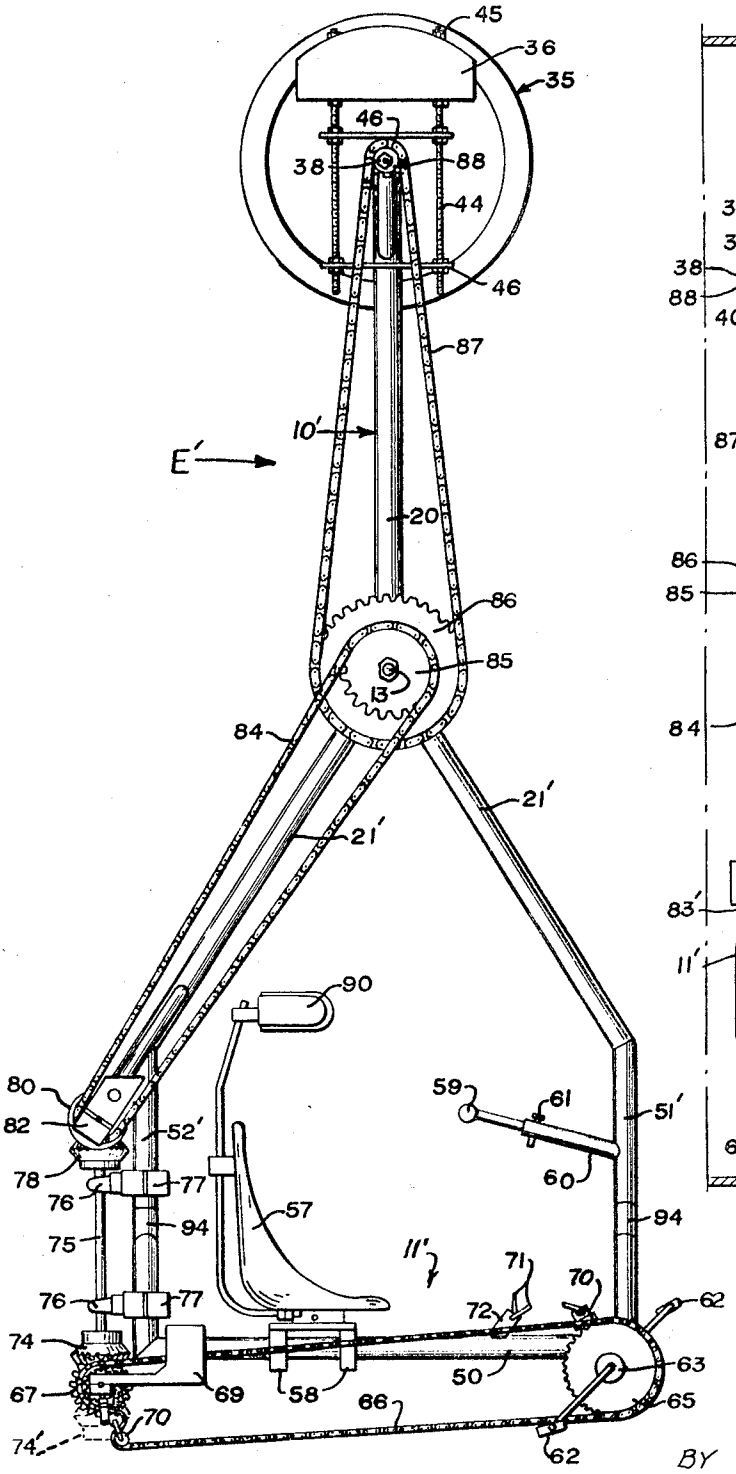


Fig. 7

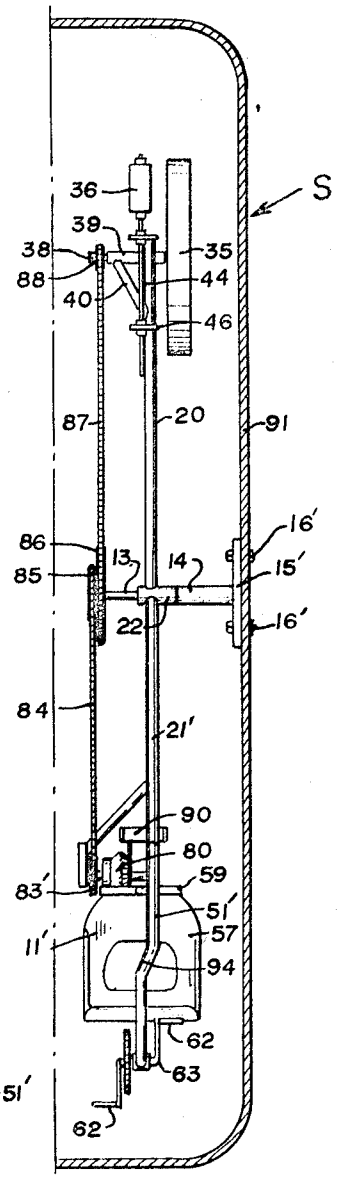


Fig. 8

INVENTOR.
Donald A. Justice
BY Van Valkenburgh & Howe

ATTORNEYS

United States Patent Office

3,467,373

Patented Sept. 16, 1969

3,467,373

CENTRIFUGAL EXERCISER

Donald A. Justice, Evergreen, Colo., assignor to Martin-Marietta Corporation, New York, N.Y., a corporation of Maryland

Filed Dec. 17, 1965, Ser. No. 525,271

Int. Cl. A63g 1/12, 1/00; G09b 9/08

U.S. Cl. 272—33 13 Claims

ABSTRACT OF THE DISCLOSURE

The centrifugal apparatus includes an elongated frame which is supported for rotation at its central portion. The frame carries a cradle at one end which is adapted to accommodate a passenger and a counterweight disposed at the opposite end of the frame. The counterweight is adjustable to compensate for different passenger weights. The counterweight includes a rotatable flywheel mounted for rotation about an axis parallel to the axis of rotation of the frame. A manual drive means is provided for rotating the frame and comprises a pedal device located on the cradle and driven by the passenger. The drive is transmitted from the pedals to the rotatable flywheel and drives the flywheel in one direction of rotation which in turn rotates the frame in the opposite direction.

This invention relates to vehicular exercising apparatus and more particularly to rotary vehicular exercisers, which simultaneously supply artifical gravity, wherein a passenger will spin about a circular path.

A primary object of the present invention is to provide a novel construction of a rotary vehicle for use as an exerciser and for spinning a passenger about a circular path with sufficient rapidity to create a substantial centrifugal force upon the passenger's body. As such, the invention will be hereinafter called a "centrifugal exerciser."

It is anticipated that the centrifugal exerciser, the present invention, can be advantageously used in space travel, and accordingly, another object of the invention is to provide a novel and improved centrifugal exerciser which is a self-propelled unit capable of operating in a zero-gravity environment as in a spaceship.

As more extensive trips into outer space are being planned, the physiological effects of prolonged living in a zero-gravity, weightless environment become a matter of concern. For example, it has been observed that an astronaut's rate of heart beat will slow down significantly after a few days in space, but will speed up considerably above normal as he is returning to earth. Another concern is an undesirable loss of muscle tone in a prolonged weightless environment. It is generally conceded that these observed, and other physical changes can bring about severe and even dangerous physical reactions after a prolonged trip into space.

It has been suggested that a space traveler can avoid the deleterious effects which may be produced by weightlessness through periodic and repeated exercises of a type which not only stimulate the individual's physique, but also produces a simulated gravitational effect on his body. The natural and obvious mode of simulating gravity effects is to place an individual at the rim of a whirling

apparatus to impose centrifugal forces upon his body during an exercise period. Such centrifugal forces may vary in intensity depending upon the speed of rotation of the apparatus and insofar as the individual is concerned, produce the same effect as if he were on the earth's surface.

Although the concept of such means for maintaining the physical condition of spacecraft crews is generally accepted, the weight penalty of such apparatus appears at first to be prohibitive, not only because of the weight and bulk of the device itself but, more important, because of the weight of propellants required to cancel out the reaction of the device upon the spacecraft by use of the spacecraft altitude control system.

Accordingly, an object of the invention is to provide a novel and improved centrifugal exerciser which is a compact, lightweight unit, of a carefully balanced construction and which may be easily incorporated into a spaceship design.

Another object of the invention is to provide a novel and improved centrifugal exerciser for a spaceship which is manually operated by a passenger, commencing as from a position at rest, as within a spaceship, easily rotated to the speed which produces a desired centrifugal effect, and thereafter returned to the original resting position.

A further object of the invention is to provide a novel and improved centrifugal exerciser for a spaceship which is a self-contained, well-balanced unit which will not vibrate or wobble on its mounting spindle within the spaceship and which may be accelerated to any desired speed of rotation without imposing torque upon its mounting spindle or on the spaceship.

Another important object of the invention is to provide a novel and improved centrifugal exerciser which may be used in a zero-gravity environment and also may be used in a normal terrestrial gravity environment with slight modifications.

Another object of the invention is to provide a novel and improved centrifugal exerciser which can be built, tested and proven through the construction of a terrestrial unit, to produce a compact, efficient, reliable unit for zero-gravity use.

A further object of the invention is to provide, in a centrifugal exerciser, a unique arrangement of counterweights and balancing members to produce a self-contained, fully-balanced apparatus with a minimum possible overall weight and bulk.

With the foregoing and other objects in view, all of which more fully hereinafter appear, my invention comprises certain constructions, combinations and arrangements of parts and elements as hereinafter described, defined in the appended claims and illustrated in preferred embodiments in the accompanying drawing, in which:

FIGURE 1 is a perspective view of a first embodiment of the centrifugal exerciser, illustrating the same as carrying a passenger and with broken lines at one portion indicating the manner in which the passenger-carrying cradle section swings when the apparatus is in use.

FIGURE 2 is a fragmentary sectional detail of the counterbalancing portion of the apparatus as taken substantially from the indicated line 2—2 at FIG. 1.

FIGURE 3 is a fragmentary sectional detail of the central mounting pivot of the apparatus as taken substantially from the indicated line 3—3 at FIG. 1.

FIGURE 4 is a front perspective view of the passenger-carrying cradle of the apparatus as taken substantially from the indicated arrow 4 at FIG. 1.

FIGURE 5 is a rear perspective view of the passenger-carrying section of the apparatus as taken substantially from the indicated arrow 5 at FIG. 1.

FIGURE 6 is a fragmentary elevational detail view as taken from the indicated arrow 6 at FIG. 5.

FIGURE 7 is a side elevational view of a second embodiment of the centrifugal exerciser, which is especially adapted to be used in a zero-gravity environment.

FIGURE 8 is a reduced-scale, front elevational view of the exerciser illustrated at FIG. 7, wherein the apparatus is illustrated as being mounted within an annular housing as at an end of a spaceship compartment.

The improved centrifugal exerciser was conceived and developed to produce a terrestrial unit which can be easily modified for use in a zero-gravity environment, as in a spaceship. To accomplish this, the terrestrial unit was designed to rotate in a horizontal plane, about a vertical spindle axis, so that gravity forces on the apparatus would be normal to the plane of rotation, and would not produce components in this rotative plane. Accordingly, the balancing-out of gravity forces at each side of the vertical spindle axis produces a condition simulating a zero-gravity environment in the horizontal plane of rotation.

The exerciser is, basically, a longitudinally-extended structure, mounted upon a central vertical spindle. It is adapted to carry a passenger at one side of the spindle and counterweights at the opposite side thereof. The apparatus must be carefully balanced upon this central spindle to avoid vibration and wobbling as it is rotated. Such balancing is of considerable importance since the comparatively light weight of the spaceship, wherein a zero-gravity unit may be used, simply cannot serve as a buttress to take care of irregularities of weight distribution in the apparatus. Also, the frame connection to the spindle must be substantially frictionless to prevent torque from being imparted to the spaceship as the exerciser is rotated. Moreover, the exerciser must be self-contained in that external torque action cannot be used to initiate rotation and to later stop the rotation without disturbing the orientation of the spacecraft.

The physical phenomenon involved in rendering the exerciser a self-contained, self-operating unit involves the application of conservation of momentum and in this instance, the conservation of angular momentum. Accordingly, the invention includes the concept of providing a flywheel adapted to be at rest whenever the exerciser is at rest and to be rotated in one direction to rotate the exerciser in the opposite direction. In order to minimize the overall weight of the apparatus, this flywheel is mounted away from the spindle to serve also as a counterweight. It thus serves a double function, to balance the apparatus, including a passenger, on the central pivot and to create angular momentum to rotate the apparatus. As an exerciser, it is further contemplated that this flywheel will be rotated by efforts of the passenger through suitable drive mechanisms, as will be set forth in detail.

Referring more particularly to the drawing, the terrestrial unit of a centrifugal exerciser E is illustrated at FIGS. 1 to 6. A modified unit E', for a zero-gravity environment, is illustrated at FIGS. 7 and 8, as will be hereinafter further described. The exerciser E is formed as an elongated Y-frame **10** having a passenger-carrying cradle **11** at one end and a counterweight assembly **12** at the other end. The frame **10** is supported upon a central spindle **13** which, in turn, is mounted in a vertical post **14**. The post, holding the spindle vertically, is formed with a flange **15** at its base to permit it to be securely anchored to a floor, as by lug bolts **16** extending through suitable holes in the flange and into the floor.

The Y-frame **10** is formed of lightweight, tubular structural members suitably welded together. It includes a leg **20** at one side of the spindle to carry the counterweight assembly **12** and a pair of diverging arms **21** at the other side of the spindle to support the passenger cradle **11**. The length of the legs and arms is such as to provide a balance point at the crotch of the Y where the leg and arms come together. The frame includes a short, tubular sleeve **22** at this crotch which is suitably welded to the frame members to depend normally from the plane of the Y-frame and to hold the spindle **13**. Reinforcing struts **23** connect the leg **20** and arms **21** with the lower end of the sleeve **22** to enhance the strength and rigidity of the assembly.

As seen in FIG. 3, the spindle **13** is a cylindrical rod which is stepped into sections of decreasing diameter. A base section **24**, of maximum diameter, fits into a socketed plug **25** at the top of the post **14**. Rivets **26** extending through the top of the post hold these members together. An intermediate spindle section **27** of smaller diameter extends through and above the frame sleeve **22** and supports the frame by a pair of radial-thrust type bearings **28** on the spindle and within the sleeve. A lower bearing sets upon the shoulder **29** between the base and intermediate sections of the spindle and is fitted into the lower end of the sleeve **22**. A spacer tube **30** within the sleeve separates the upper and lower bearings **28**. The upper bearing is at the top end of the sleeve and abuts against an inturned flange **31** of the sleeve to support the frame **10** upon the spindle **13**. An upper section **32** at the top of the spindle, of further reduced diameter, holds a pair of bearings **33** which support idler sprockets, hereinafter described.

The counterweight assembly **12** at the outward end of the leg **20** includes a flywheel **35** and a fixed weight **36**. The flywheel serves two functions, first, to impart angular momentum to rotate the apparatus, and secondly, to supplement the fixed weight **36** in balancing the weight of a passenger at the opposite end of the apparatus. Accordingly, the flywheel **35** is a comparatively heavy member with a heavy rim **37**. It is mounted to lie in a horizontal plane at the underside of the leg **20** and is carried by a vertical shaft **38** which extends upwardly and through sleeve **39** near the end of the leg. The sleeve **39** is formed of tubular members extending through and upstanding from the leg **20**, suitably welded into position on the leg and further secured by a strut **40**, as shown at FIG. 2. The shaft **38** is mounted in this sleeve **39** by a pair of bearings **41**, one being positioned at the bottom of the sleeve against an inwardly turned flange **42** and the other at the top of the sleeve in a socket **43**. The top portion of the shaft **38** extends above the sleeve to carry a drive sprocket, hereinafter described.

The fixed weight **36** is adjustable to shift outwardly and inwardly from the leg **20** so that it may be positioned to balance the apparatus to the different weights of the individuals who may use it. It is mounted upon a pair of threaded rods **44** which lie in spaced parallelism with the leg **20**, which each rod being at one side of the leg and extending beyond the outward end of the leg. Each outwardly extended rod portion fits into a hole through the weight and is fastened to the weight by lock nuts **45**. The rods are also affixed to the leg **20** by a pair of rectangular brackets **46**. Each bracket is transversely mounted on the leg, with one bracket being at the end of the leg and the other being spaced a short distance inwardly from the end thereof. Each bracket includes a pair of holes wherethrough the rods are extended, and the rods are adjustably positioned upon these brackets by opposing lock nuts **45**, as in the manner illustrated at FIG. 2.

Where the apparatus is used frequently by many persons and adjustments of the fixed weight **36** are also frequent, it is contemplated that the adjustments may be controlled by a servo mechanism, not shown, by eliminating the nut **45** which connect the rods to the brackets **46** and replacing them with shifting screws affixed to a bracket

and rotated by the servo mechanism. However, a manually adjustable apparatus, such as that illustrated, is preferable for the sake of simplicity where adjustments of this weight will not be excessively frequent.

The passenger cradle **11** is formed as a squat, U-shaped structure having a transversely disposed base tube **50** and a front arm **51** and a rear arm **52** upstanding from the respective ends of the base tube, as clearly seen in FIG. 5. The top ends of the cradle arms lie between and are pivotally connected to the outward ends of a frame arms **21** by a front pivot rod **53** and a rear pivot rod **54** which are secured to the respective arms **51** and **52** and are aligned on a common, transverse axis. These pivot rods are suspended, respectively, in a front bearing **55** and rear bearings **56** at the ends of the frame arms **21**.

A passenger seat **57** is mounted upon the base tube **50** of the cradle at a position adjacent to the rear arm **52**, the mounting being effected by a clamp head **58** at the underside of the seat. A balancing handle **59** is mounted upon a post **60** which is attached to the front arm **51** to extend rearwardly from that arm and place the handle at a position where a passenger may easily grip it. The post **60** is adjustable in length by providing two telescopically interconnected tubular portions which may be locked together as by a pin **61** extending through suitable registering holes in the post portions. To complete the cradle, a manual driving mechanism is mounted on the base tube **50**, the preferred driving mechanism, as illustrated, is a pedal system similar to a bicycle drive, as will be hereinafter further described.

With this arrangement, the cradle **11** is suspended in the horizontally disposed frame **10** to hang vertically therefrom when the apparatus is at rest, but to swing outwardly and away from the frame **10** as it is being rotated, as in the manner indicated by the broken-line portion of the arm **51**, illustrated at FIG. 1. The centrifugal force producing this outward swing of the cradle is a horizontal component proportional to the speed of rotation of the apparatus. The gravity force, due to the weight of the passenger and cradle, is a vertical component which remains constant and which is not influenced by, nor influences, the horizontal centrifugal forces. Accordingly, excepting for a small unbalance due to the outward swing of the cradle as it speeds rotation, the horizontal components of forces and momentum effects on the apparatus, which vary according to the speed of rotation of the apparatus, will simulate the action of the apparatus in a zero-gravity environment.

The manual drive includes a train of mechanisms which extend from foot pedals **62** at the lower front end of the cradle to the flywheel **35** at the opposite end of the apparatus, as best seen in FIG. 1. The first section of this train of mechanisms includes the pedals **62** at each side of a pedal shaft **63** which is mounted in a frame bearing **64** secured to the underside of the forward end of the base tube **50**. A nest of three drive sprockets **65**, of different diameters, is carried on this pedal shaft and a chain **66** is meshed upon one of the sprockets to extend rearwardly to mesh with one of a nest of rear driven sprockets **67**, clearly shown in FIG. 4. These rear sprockets **67** are mounted upon a shaft **68** carried in a U-shaped bracket **69** which is clamped to the base tube **50** to extend rearwardly of the rear arm **52** of a cradle, as in FIG. 5. The pedals, driving sprockets **65**, chain **66** and driven sprockets **67** are similar to a conventional bicycle drive. To obtain variable speeds of operation, the chain is shifted from one sprocket to another at either the front sprocket nest **65** or the rear sprocket nest by conventional bicycle derailing devices, generally indicated as **70** in FIGS. 4 and 5, which is regulated by controls **71** affixed to suitable spurs **72** upstanding from the base tube **50**.

The nest of driven sprockets **67** is connected with a first bevel gear **73**, on the shaft **68**. This bevel gear meshes with a second bevel gear **74**, as best seen in FIG. 5, which is mounted on the end of a shaft **75**, perpendicular to the shaft **68** and paralleling the arm **52**. This shaft **75** is mounted in bearings **76** secured to the arm **52** by clamp heads **77**. A third bevel gear **78** is mounted at the top of the shaft **75** adjacent to the pivot rod **54** which connects the rear arm **52** of the cradle with the frame arm **21**. A fourth bevel gear **79**, an idler gear, is mounted upon an extension of this rear pivot rod **54** to mesh with the third gear and also mesh with a fifth bevel gear **80** which is mounted upon a shaft **81** carried in a pivot block **82**, as in FIG. 6, attached to the end of the rear frame arm **21**, the block **82** also supporting the rear bearings **56**, heretofore described. A strut **40** upstanding from the frame arm **21** reinforces this block **82** on the arm **21**. It follows that swinging movements of the cradle **11** about the frame pivots rods **53** and **54** are possible with the bevel gears **78** and **80** at each side of the idler **79** remaining in mesh with idler and with the train of mechanisms being interconnected regardless of the position assumed by the cradle **11**.

The shaft **81** upstands from the frame arm **21** within the bracket block **82** and a first frame sprocket **83** is mounted on shaft **81** above the fifth bevel gear **80**. A chain **84** extends from the sprocket **83** above the arm **21** towards the crotch of the Y-frame to connect with a second sprocket **85** mounted upon the upper section **32** of the spindle **13**, on a bearing **33**. This second sprocket is interconnected with a third sprocket **86** also mounted upon the spindle section on another bearing **33**. The sprocket group **85** and **86** thus idle on spindle **13**. A chain **87** extends from this third sprocket **86** to a fourth sprocket **88** which is mounted upon the flywheel shaft **38** to complete the assembly.

The apparatus is simple to operate. Once it is balanced for a passenger, the passenger simply mounts the apparatus in the seat **57**, and may secure himself therein with a safety belt **89**, as indicated at FIG. 1. Also, a headrest **90**, extending above the seat, is desirable to help hold the passenger's head in a fixed position. To commence, he shifts the chain **66** onto any selected pair of sprockets **65** and **67** and simply commences to turn the mechanisms with the foot pedals **62** and thereby commence to rotate the flywheel **35**. The rotation of the flywheel effects a counter rotation of the apparatus about the spindle **13**. To increase the speed of rotation, the passenger may shift chain **66** to other pairs of sprockets **65** and **67**, the same as a bicycle rider shifts the chain on the bicycle sprockets. As the speed of rotation is increased, the passenger's cradle swings outwardly, and the cradle is adapted to swing to an angle of approximately 75 degrees from the vertical rest position. The limiting swing is where the teeth of the third bevel gear **78** commences to contact the teeth of the fifth bevel gear **80**. Accordingly, a centrifugal force of approximately twice gravity is possible with the apparatus. To prevent an excessive upswing from clashing the bevel gears **78** and **80**, a stop, not shown, may be mounted upon a frame arm **21** adjacent to the bearing, **55** or **56**, to contact the end of the cradle arm, **51** or **52**.

To stop the apparatus, the operator need only to slow down and stop turning the pedals **62**. In a more elaborate construction than that shown, a ratchet mechanism at the pedal, or elsewhere, may be used to permit the train of mechanisms to be disengaged when the passenger stops pedaling and a brake may be used to stop the spinning of the flywheel.

The exerciser E, illustrated at FIGS. 1 to 6, may be easily modified for use in a zero-gravity environment by an actual simplification of the construction of the unit. The exerciser E', illustrated at FIGS. 7 and 8, is exemplary of such modification. The frame **10'** and the passenger cradle **11'** are rigidly interconnected by welding the arms **51'** and **52'** to the frame arms **21'**, and with the arms **51'** and **52'** lying in the same plane as arms **21'**. This modification eliminates pivot rods **53** and **54**, bearings **55** and **56** and the idler bevel gear **79**. With the respective arms in a common plane, the bevel gear **78** is

directly connected to the bevel gear **80**, as illustrated. It is to be noted that the elimination of the idler bevel gear reverses the direction of flywheel rotation with respect to rotation of the foot pedals, and in order to rotate the exerciser forwardly, with respect to the passenger's position, the foot pedals will have to be turned in a direction which is normally backwards. However, if reverse pedaling is undesirable, the second bevel gear **74'** may be relocated as to the position indicated in broken lines at FIG. 7 by suitable modifications of the bracket **69** and the shafts **68** and **75**.

This apparatus may be mounted in a cylindrical end of a spaceship S to rotate in a plane parallel to the endwall **91** of the ship. The spindle **13** of the apparatus is mounted in a post **14'** which, in turn, is mounted at the center of the endwall **91**. This post may be rigidly affixed to the ship endwall **91**, as by flange **15'** attached thereto by bolts **16'**. Where the apparatus is mounted in a zero-gravity environment and angular momentum is imparted to it, as by rotation of the flywheel, without any other displacement, the unit will naturally commence rotating about an axis which is a true centroid of the apparatus. The adjustments to the fixed weight **36** will place the centroid of the apparatus as close as possible to the axis of the spindle **13**. If this is not done, excessive vibration will be imparted to the spaceship as the exerciser is rotated should the post **14'** be rigidly affixed to the wall.

It is important that this apparatus be dynamically balanced when a passenger is mounted in the seat **57**, not only with respect to radial centrifugal actions from a centroid as at the axis of the spindle **13**, but also with respect to acceleration movements of portions of the system parallel to the spindle axis. This latter action tends to create a wobbling of the exerciser upon the spindle. Accordingly, it is important that the center of gravity of the counterweight assembly at one side of the apparatus and of the passenger's cradle and passenger therewithin at the other side of the apparatus be at diametrically opposing points which would lie on a line which intersects and is normal to the spindle axis. To provide such, the cradle arms **51'** and **52'** may be provided with offsets **94** to facilitate lining up and balancing the apparatus.

While I have now described my invention in considerable detail, it is obvious that others skilled in the art can build and devise alternate and equivalent constructions which are nevertheless within the spirit and scope of my invention. Hence, I desire that my protection be limited, not by the constructions illustrated and described, but only by the proper scope of the appended claims.

What is claimed is:

1. A centrifugal exerciser mounted upon a spindle and being adapted to rotate freely thereabout, and comprising, in combination therewith, an elongated frame having a spindle mount at its central portion, a cradle at one end of the frame adapted to support a passenger, a counterweight assembly at the other end of the frame adapted to balance the apparatus upon the spindle with a passenger in the cradle, a flywheel carried upon the frame and having its axis parallel to the spindle axis and being adapted to be rotated with respect to the frame in one direction and thereby impart rotation to the frame in the opposite direction, and a manually operable drive means operable by a passenger in the cradle adapted to rotate the flywheel.

2. A centrifugal exerciser mounted upon a spindle and being adapted to rotate thereabout, and comprising, in combination therewith, an elongated frame having a substantially frictionless spindle mount at its central portion, a cradle at one end of the frame adapted to support a passenger, a counterweight assembly at the other end of the frame adapted to balance the apparatus with a passenger in the cradle, wherein the counterweight assembly includes a flywheel having its axis parallel to the spindle axis and being adapted to be rotated with respect to the frame in one direction to impart rotation to the frame in the opposite direction, means on the frame adapted to rotate the flywheel, and said flywheel rotating means extends from the flywheel to the passenger's cradle and includes manually operable driving means whereby the flywheel is rotated manually, as by the efforts of the passenger in the cradle.

3. In the exerciser defined in claim **2**, wherein said counterweight assembly includes a fixed weight attached to the frame and adapted to be shifted along the frame, towards and away from the spindle, and set at a selected position on the frame to counterbalance the weight of a specific passenger.

4. In the exerciser defined in claim **2**, wherein the spindle is mounted upon a vertical post and the frame is adapted to rotate in a horizontal plane about the post, and wherein the passenger's cradle is pivotally suspended from the frame and is thereby adapted to hang from the end of the frame when the apparatus is not rotating, but is adapted to swing outwardly when the apparatus is rotating about the spindle.

5. In the exerciser defined in claim **4**, wherein said frame is Y-shaped with the spindle means being adjacent to the crotch of the Y and with the cradle being formed as a U-shaped frame pivotally suspended between the arms of the Y.

6. In the exerciser defined in claim **2**, wherein said frame is Y-shaped with the spindle means adjacent to the crotch of the Y, the cradle is formed as a U-shaped frame suspended between the arms of the Y and includes a passenger seat at one end thereof and driving means in front of the passenger's seat adapted to be operated by the passenger, said driving means being operatively connected to the flywheel and being adapted to rotate the same.

7. In the exerciser set forth in claim **6**, wherein said driving means includes a cranking means at the passenger's cradle and a train of mechanisms interconnecting the cranking means and the flywheel.

8. In the exerciser set forth in claim **6**, wherein said driving means includes a pedal drive adapted to be turned by the passenger, a train of mechanisms interconnecting from the pedal drive to the flywheel, including sprockets and chain means paralleling the frame.

9. In the exerciser set forth in claim **6**, wherein said driving means includes a pedal drive at the base of the passenger cradle, a shaft extending alongside an arm of the cradle to the Y-arm of the frame, a sprocket at the end of the Y-arm interconnected to the shaft by pinions, a sprocket at the flywheel and chain means interconnecting the sprockets.

10. In the exerciser set forth in claim **9**, including idler sprockets at the spindle.

11. In the exerciser set forth in claim **6**, wherein said frame and passenger's cradle are in a common plane.

12. In the exerciser set forth in claim **6** wherein the passenger's cradle is pivoted to the frame to permit the cradle to hang vertically when the frame is oriented horizontally upon a vertically axised spindle and to swing outwardly from the vertical as the frame is rotated about the spindle.

13. A centrifugal exerciser for a zero-gravity environment, as in a spaceship, and comprising:

a member adapted to be attached to the wall of the ship to normally restrain the apparatus;

an elongated frame having a Y-shaped configuration with a central leg at one side and spreading arms oppositely thereto;

a low-friction bearing attached to the central portion of said frame pivotally engaging said member and having an axis which is normal to the plane of said frame;

a U-shaped passenger-carrying cradle having its arms connected with the ends of the arms of the Y-frame as a continuation thereof;

a counterweight assembly at the outward end of the frame leg including a fixed weight and a flywheel lying in a plane paralleling the plane of rotation, said

counterweight assembly being proportioned to place the centroid of the system substantially at the bearing axis when a passenger is in place in the cradle; and

manually driven means at the passenger's cradle extending to the flywheel, and adapted to be operated by a passenger to rotate the flywheel, whereby rotation of the flywheel imparts a counter rotation of the frame.

References Cited

UNITED STATES PATENTS

548,450 10/1895 Norcross ---------- 272—33

1,123,653 1/1915 Anderson et al. ---------- 272—33

1,250,266 12/1917 Banks ---------- 46—50

3,010,219 11/1961 Schueller ---------- 272—36 X

3,092,918 6/1963 Haeussermann et al.

ANTON O. OECHSLE, Primary Examiner

ARNOLD W. KRAMER, Assistant Examiner

U.S. Cl. X.R.

35—12; 244—1; 272—41