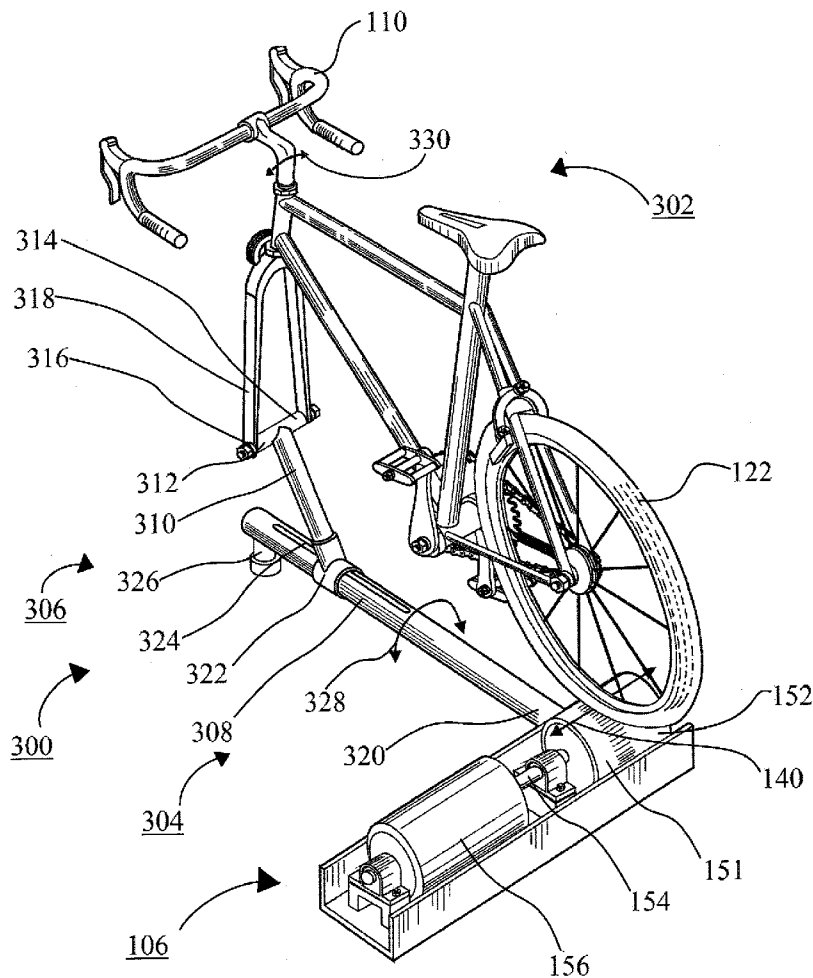


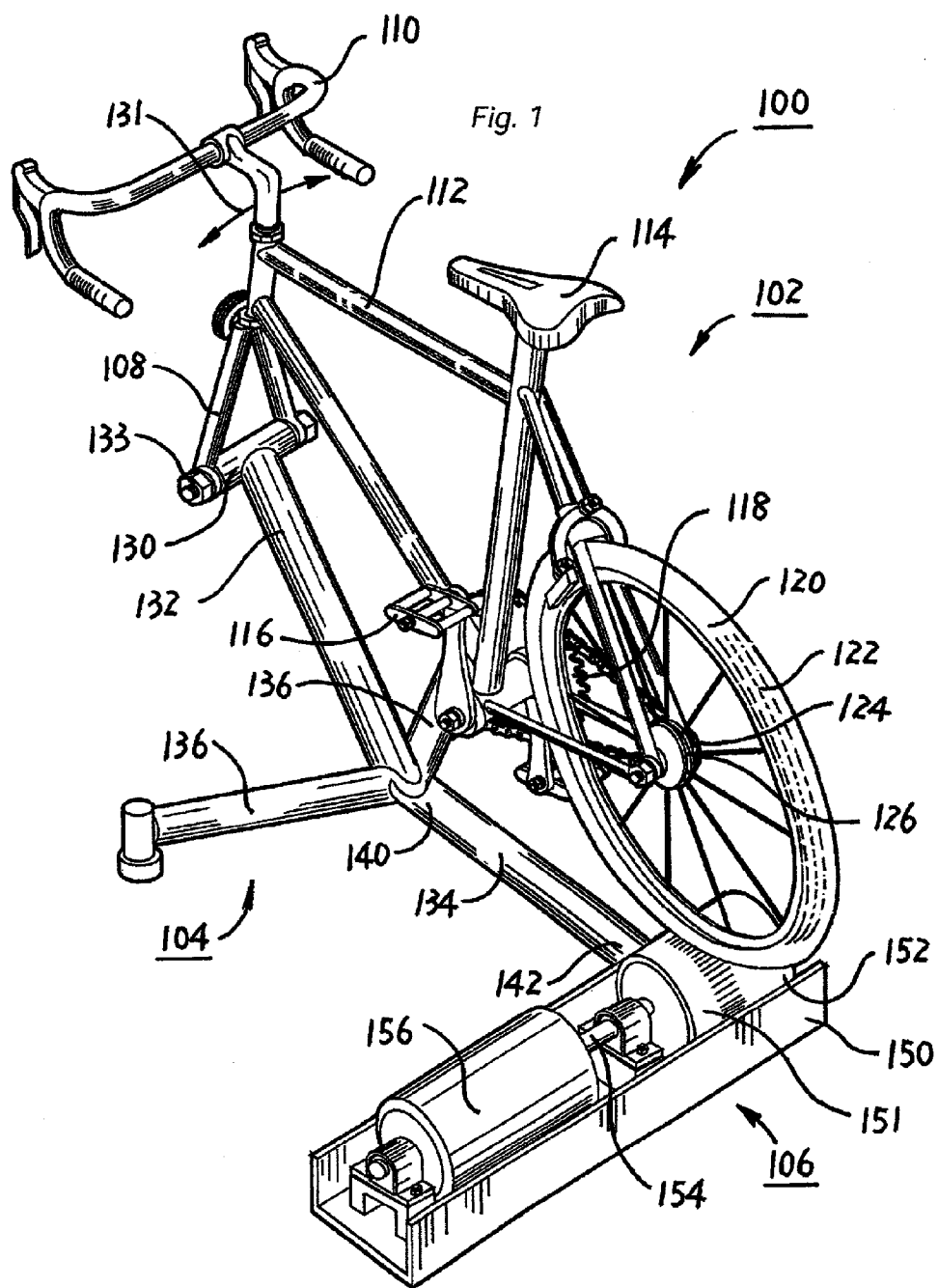


US 20160158620A1

(19) **United States**(12) **Patent Application Publication**
Bauer et al.(10) **Pub. No.: US 2016/0158620 A1**(43) **Pub. Date: Jun. 9, 2016**(54) **BICYCLE TRAINER**(71) Applicant: **Velo Reality Corp.**, Niagara Falls (CA)(72) Inventors: **Gary Bauer**, Niagara Falls (CA);
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2069/162 (2013.01); *A63B 2069/164* (2013.01);
A63B 2220/51 (2013.01); *A63B 2220/78*
(2013.01)(21) Appl. No.: **14/983,737**(22) Filed: **Dec. 30, 2015****Related U.S. Application Data**(63) Continuation of application No. 14/460,459, filed on
Aug. 15, 2014.**Publication Classification**(51) **Int. Cl.**
A63B 69/16 (2006.01)
A63B 21/005 (2006.01)
A63B 24/00 (2006.01)
(52) **U.S. Cl.**
CPC *A63B 69/16* (2013.01); *A63B 24/0087*(57) **ABSTRACT**

The present invention is a bicycle trainer that allows a person to utilize their own bicycle and simulates real and varied road conditions. The device includes the front forks of a bicycle mounted to a stand; the stand including a flexible support arm allowing the bicycle to rock back and forth along a rocking arc; and the rear tire of the bicycle making contact with a roller face of a roller such that the roller is free to rotate in proportion to the rotation of the rear tire. Further, the roller is rotationally connected to a motor for selectively applying resistance and assistance to the rear tire rotation, for simulating real course conditions. Preferably it further includes a motor assembly which includes a frame for housing the roller and motor and rigidly connecting the motor assembly to the stand, the motor is pivotally mounted to the frame about its shaft, such that the motor and roller rotate in proportional unison with each other.





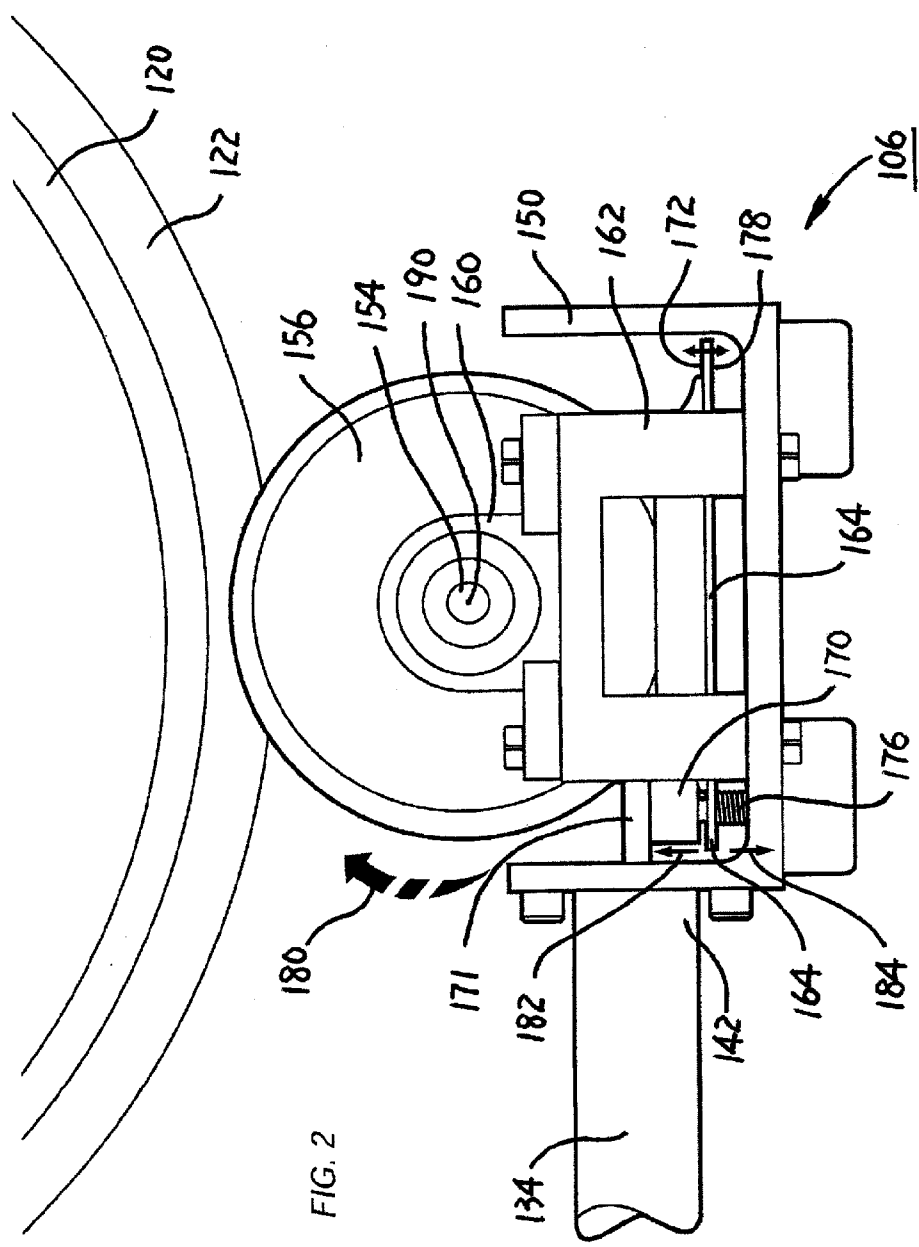


FIG. 3

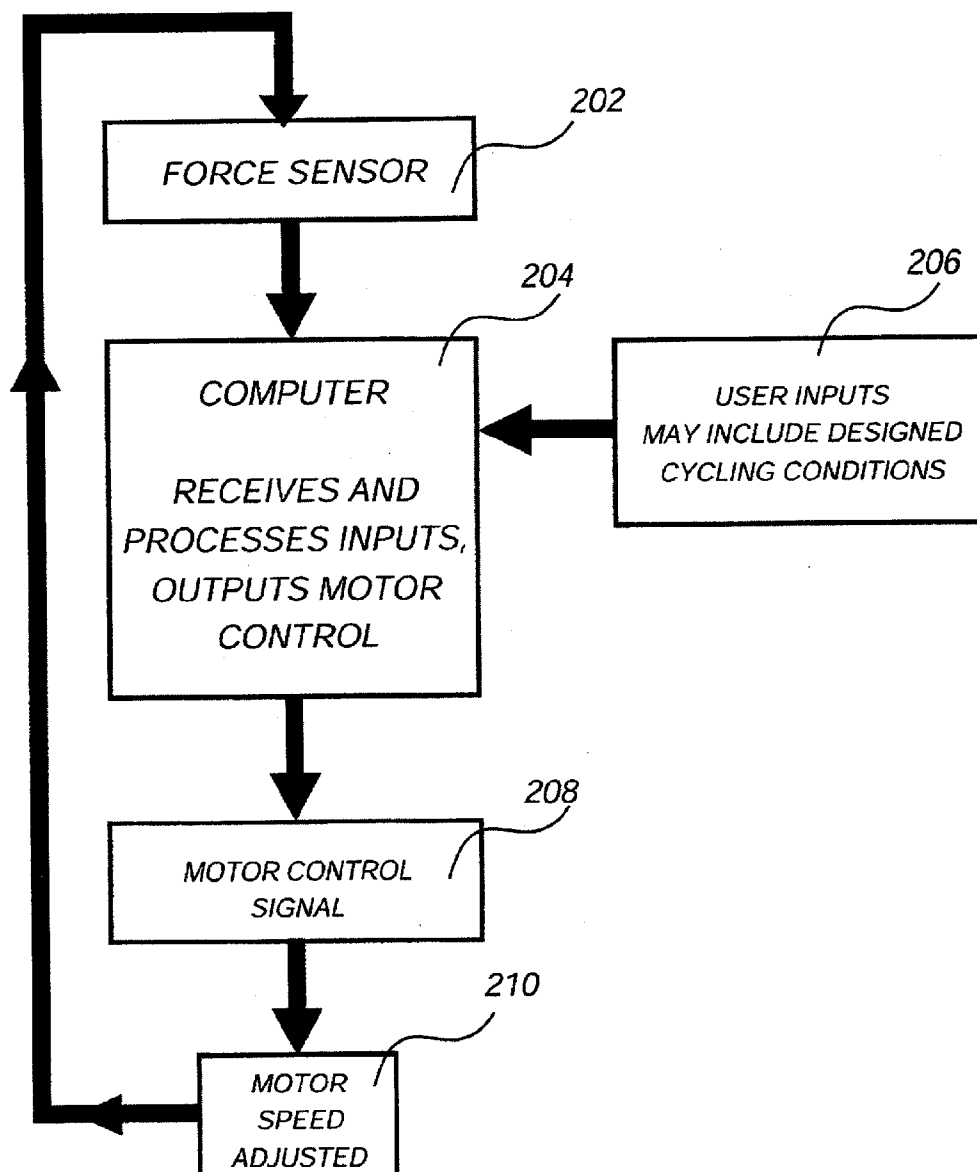
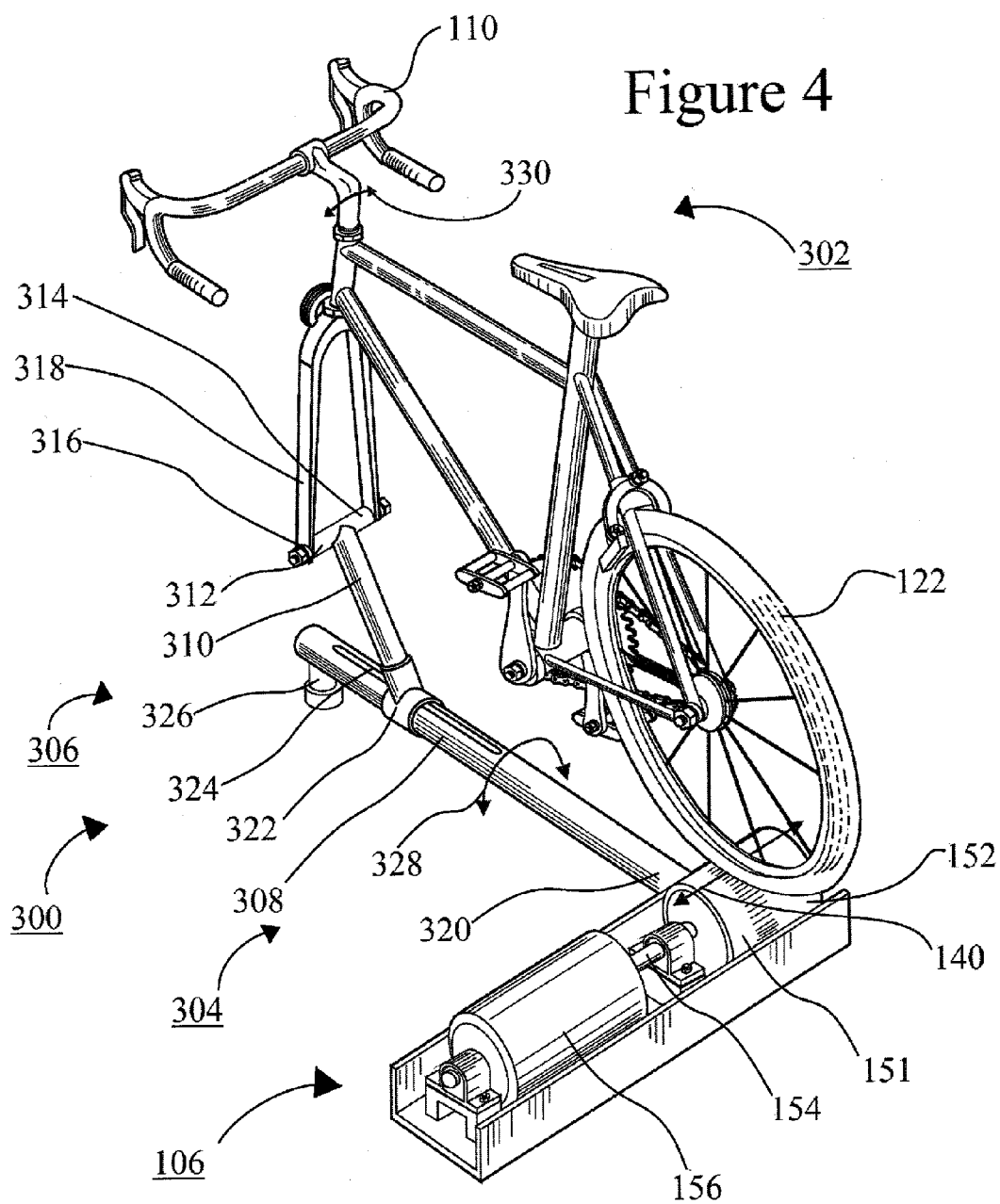


Figure 4



BICYCLE TRAINER

[0001] This application is a continuation in part of U.S. Ser. No. 14/460,459 filed Aug. 15, 2014 by Gary Bauer, Konstantine Poukhov, and Nikolay Bakunin which application claims priority from regularly filed U.S. provisional application No. 61/872,942 filed Sep. 3, 2014 by Gary Bauer, Konstantine Poukhov, Nikolay Bakunin under the title BICYCLE TRAINER.

FIELD OF THE INVENTION

[0002] The present concept relates to bicycle trainers and more particularly relates to a bicycle trainer that can simulate actual road conditions and utilize the riders own bicycle for the training exercise.

BACKGROUND OF THE INVENTION

[0003] There are numerous bicycle trainers which are known in the prior art some of which have been patented including U.S. Pat. No. 7,862,476 titled: Exercise Device, by David A. Blau et al. which was issued on Jan. 4, 2011.

[0004] The exercise device described in U.S. Pat. No. 7,862,476 does not enable the person to utilize his or her own bicycle nor does it simulate real road conditions, in particular it does not simulate the freedom of movement available on a regular bicycle in real life conditions.

[0005] Most of the bicycle training devices utilize a rigid stand and/or setup such as that described in U.S. Pat. No. 7,862,476 in which the user will sit in a simulated environment and pedal a bicycle like machine which attempts to simulate real road conditions.

[0006] There is a need for a bicycle training device which allows a user to utilize his own bicycle which the rider has become comfortable with and allow the freedom of movement that a real bicycle allows when pedaling on a normal road surface.

SUMMARY

[0007] The present concept a bicycle trainer comprising:

[0008] a) the front forks of a bicycle mounted to a stand;

[0009] b) the stand including a flexible support arm allowing the bicycle to rock back and forth along a rocking arc;

[0010] c) the rear tire of the bicycle making contact with a roller face of a roller such that the roller is free to rotate in proportion to the rotation of rear tire;

[0011] d) wherein the roller is rotationally connected to a motor for selectively applying resistance and assistance to the rear tire rotation, for simulating real course conditions.

[0012] Preferably further comprising a motor assembly which includes a frame for housing the roller and motor and rigidly connecting the motor assembly to the stand, the motor is pivotally mounted to the frame about its shaft, such that the motor and roller rotate in proportional unison with each other.

[0013] Preferably wherein the motor assembly further including a force sensor for measuring the tangential force between the roller and the bicycle.

[0014] Preferably wherein the motor is rigidly mounted to a base plate which has a top side and bottom side which is free to pivot with the motor.

[0015] Preferably wherein the motor assembly includes the force sensor in contact with one side of the plate, and a spring

on the other side of the plate such that the force sensor and spring restrict the rotational deflection of the base plate and thereby measure the tangential force between the roller.

[0016] Preferably where the force sensor and spring are opposing each other mounted on opposite sides of the plate, in order to maintain positive bias of force on the force sensor.

[0017] Preferably wherein the force sensor is chosen from the group comprising piezo electric, and strain gauge and load cell and magneto elastic transducers.

[0018] Preferably further including a controller which includes data sets for simulating real and imaginary road conditions.

[0019] The present concept is a bicycle trainer for use with a bicycle with its front tire removed from the fork dropout comprising:

[0020] a) a stand which includes a flexible connecting arm connected to a motor assembly at a tire end of the flexible connecting arm;

[0021] b) a fork end of the flexible connecting arm dimensioned to attach to the front fork dropout of a bicycle;

[0022] c) the motor assembly includes a roller with a roller face, wherein the rear tire of the bicycle making contact with a roller face of the roller such that the roller is free to rotate in proportion to the rotation of rear tire and further the tire is free to move in a lateral direction across a portion of the face of the roller;

[0023] d) a motor is rotationally connected to the roller for selectively applying resistance and assistance to the rear tire rotation, for simulating real course conditions.

[0024] Preferably wherein the flexible connecting arm is dimensioned and selected to allow torsional flex of the flexible connecting arm such that the bicycle will rock back and forth along a rocking arc when the rider imparts torsional forces onto the stand.

[0025] Preferably also comprising a motor assembly which includes a frame for housing the roller and motor and also for rigidly connecting the motor assembly to the stand, the motor is rotationally mounted about its shaft with limited pivotal movement to the frame, such that the motor and roller rotate in proportional unison with each other.

[0026] Preferably wherein the motor assembly further includes a means for measuring force.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The concept will now be described by way of example only with reference to the following drawings in which:

[0028] FIG. 1 is a schematic perspective view of a bicycle trainer which includes a bicycle mounted onto a stand and a motor assembly.

[0029] FIG. 2 is a schematic partial elevational view of the motor assembly showing part of the rear tire and rear wheel of the bicycle, and the motor assembly.

[0030] FIG. 3 is a flow diagram showing in schematic fashion the method of control of the motor.

[0031] FIG. 4 is a schematic perspective view of a further embodiment of a bicycle trainer which includes a bicycle mounted onto a stand and a motor assembly.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0032] The present concept a bicycle trainer shown generally as **100** in FIG. 1 includes the following major components namely bicycle **102**, a stand **104**, and a motor assembly **106**.

[0033] Bicycle **102** includes all of the normal components of a bicycle except for the front wheel which has been removed from the front fork **108**.

[0034] Bicycle **102** therefore will include all of the normal components found in a bicycle including handle bars **110** attached to a bicycle frame **112**, including a seat **114**, pedals **116**, a set of front sprockets **118**, a rear wheel **120** having mounted thereon a rear tire **122**, a chain **124**, engaging with a set of rear sprockets **126**.

[0035] Bicycle **102** will also include the normal front and rear gear changing device which normally is a front de-railer for selecting a front sprocket **118** and a rear gear selector for selecting one of the rear sprockets **126** thereby allowing the rider of the bicycle to choose the gear ratio.

[0036] Stand **104** includes a fork support **130** onto which front fork **108** of bicycle **102** is mounted using fork nuts **133**. Fork support **130** is connected to a flexible support arm **132** which in turn is attached to connecting arm **134** and outriggers **136**.

[0037] Connecting arm **134** is connected at 1st end **140** to outriggers **136** and flexible support arm **132** and at a 2nd end **142** to motor assembly **106**.

[0038] Motor assembly **106** includes a frame **150** which houses a roller **152** which is connected with a common shaft **154** to a motor **156**.

[0039] Referring now to FIG. 2 which is a schematic side elevational view of the motor assembly **106** showing frame **150** connected to connecting arm **134** at a 2nd end **142**.

[0040] The shaft **154** of motor **156** is mounted via bearings onto frame **150** using motor support **162**.

[0041] Therefore motor **156** is free to rotate about shaft **154** except for the fact that the motor base plate is sandwiched between a force sensor **170** on the upper side **172** of motor base plate **164** and by spring **176** on the lower side **178** of motor base plate **164**.

[0042] In other words the force sensor **170** and the spring **176** are the only elements which prevent or restrict motor **156** from rotating about shaft **154** when torque is being applied to the motor. Sensor **170** is mounted onto sensor flange **171** which in turn is mounted into frame **150**.

[0043] The direction of bicycle forward or normal roller rotation is shown as **180** and the upward deflection direction of motor base plate **164** is shown as **182** and the downward deflection direction of motor base plate **164** is shown as **184**.

[0044] Spring **176** is normally biased against motor base plate **164** therefore force sensor **170** normally sees a positive force even when motor **156** is stationary.

[0045] As torque is applied to motor **156** the reaction force of this torque will be measured by force sensor **170** thereby being able to measure instantaneously at any point in time the force being generated by motor **156** against force sensor **170**.

[0046] Rear tire **122** makes contact with roller face **151** thereby imparting rotational forces onto roller **152** which is attached to the common shaft **154** shared with motor **156**. Therefore as roller **152** rotates so does the rotor within motor **156**.

[0047] Motor base plate **164** is sandwiched between the force sensor **170** and the spring **176**. Together force sensor

170 and spring **176** prevent the motor **156** from rotating about axis of rotation **190**. The pressure on force sensor **173** allows measuring of tangential force between the roller **150** and the bicycle tire **122**.

[0048] Spring **176** provides the necessary positive force bias and allows the use of a single force sensor to measure tangential force on the roller **152** in both directions without resulting in a negative force on force sensor **170**. The force sensor may be a piezo electric, strain gauge, load cell, magneto elastic device or other commonly known force sensors or transducers.

[0049] Referring now to FIG. 3 a signal from the force sensor **170** shown as **202** is fed to a computer **204** which then receives and processes inputs from force sensor **170** and from user inputs **206** to set the current motor speed via motor control signal **208** to create a motor speed adjustment **210**. Taking into account force value from the force sensor **170**, current motor speed **156** and input parameters such as current road grade, combined weight of cyclist and the bike and wind speed the system can then calculate instant changes to motor speed **156** according to physical model of cycling in order to simulate instant forces during pedaling as would be experienced by cyclist if he rode in real life under the same input conditions. One can impart resistive or assisting forces to rear tire **122**. The system easily takes into account macro factors such as headwinds, tailwinds and up or down hill slopes. More importantly the system is fast enough to simulate changes in pedal force such as changes that occur during the stroke of the pedal.

[0050] The system recalculates and applies changes to assistive and resistive forces transmitted to the pedal at a rate of at least 100 times per second which allow real-time simulation of cycling conditions.

[0051] User inputs **206** includes a controller which includes real time data or manufactured data and may include custom data sets and/or formulas describing any particular real or imaginary model of cycling allowing for a real-time simulation of cycling conditions.

[0052] The user inputs may for example include real road condition data which has been previously collected.

In Use

[0053] The user of bicycle trainer **100** is able to use the same bicycle **102** which they use in real life conditions.

[0054] The front wheel of bicycle **102** is removed and the front forks **108** of bicycle **102** are connected to a flexible support arm **132** which allows the bicycle to rock freely side to side along rocking arc **131**.

[0055] The reader will note that the rear tire **122** mounted to the rear wheel **120** is free to move and rock side to side due to the fact that the only contact point is on the roller face **151** of roller **152**.

[0056] Therefore as the user rides bicycle **102** it is free to rock side to side wherein the degree of freedom of movement is dependent upon the flexibility of flexible support arm **132**.

[0057] Roller **152** is directly connected via a common shaft **154** to motor **156** which in practice may be an induction motor however alternative designs may include an out runner type of motor where the motors outer shell may serve as a roller, thereby eliminating the need for a separate motor & roller.

[0058] The combination of the roller **152**, the motor **156** are free to rotate about the axis of rotation **190** due to the fact that the roller **152** and motor **156** are mounted onto bearings **160**

which allow the motor to freely rotate about axis rotation **190**, with limited pivotal movement due to restriction of force sensor **170**.

Further Embodiment Described

[0059] A further embodiment of the present concept a bicycle trainer shown generally as **300** includes a connecting arm **306** with a motor assembly **106** attached at one end thereof.

[0060] Connecting arm **306** includes a longitudinal portion **308**, a support arm **310**, and a fork support **312**. Fork support **312** is located at a fork end **314** of connecting arm **306** and is dimensioned to adapt to connect to the front fork dropouts **316** of front fork **318** of bicycle **302**.

[0061] In order to mount bicycle **302** to the stand **304** the front tire of bicycle **302** is removed thereby exposing the front fork dropout **316** which then can be connected to fork support **312** as shown and depicted in FIG. 4.

[0062] Connecting arm **306** is connected at tire end **320** to motor assembly **106**. Connecting arm **306** includes a collar **322** which attaches support arm **310** to a longitudinal portion **308** in addition to a slot **324** for adjusting the positioning of the collar **322** depending on the size of the bicycle. Support leg **326** supports connecting arm **306** slightly off of the floor or ground when bicycle trainer **300** is placed onto the floor.

[0063] Connecting arm **306** is made of preselected flexible material and in particular the longitudinal portion **308** of connecting arm **306** is selected to ensure that there is enough torsional flex **328** as shown by the arrows in FIG. 4 to allow for rocking motion of bicycle **302** along rocking arc **330** as shown in FIG. 4. The rider imparts torsional forces onto the stand **304** thereby causing connecting arm **306** and in particular the horizontal portion **308** to flex torsionally as shown as torsional flex **328** in FIG. 4.

[0064] It has been found in practice that the use of 4130 alloy steel for the components of connecting arm **306** having an outside diameter of 1.25 inches and a wall thickness of 0.095 inches is adequate to provide for enough torsional flex **328** within longitudinal portion **308** of connecting arm **306** to provide for a rocking arc **330** of plus or minus 5 degrees for a total rocking arc of 10 degrees.

[0065] It has also been found that using aluminium alloy 6061 having a diameter of 50 mm and a wall thickness of 10 mm will also provide adequate torsional flex **328** to provide for a rocking arc **330** plus or minus 10 degrees for heavy riders and more typically plus or minus 5 degrees for lightweight riders.

[0066] The typical modern day bicycle depicted in FIG. 4 has a length of anywhere from 34 to 44 inches measured from the centre of the front wheel hub to the centre of the rear wheel hub. A typical bicycle has a centre to centre wheel distance of approximately 39 inches plus or minus 3 inches.

[0067] The length of longitudinal portion **308** as well as support arm **310** is dimensioned such that the tread of rear tire **122** makes contact with roller **152** as shown in FIG. 4.

[0068] The collar **322** can be moved along longitudinal portion **308** to accommodate various sizes of bicycles and thereby ensure that the rear tire **122** makes contact with the top of roller face **151** of roller **152** as depicted in FIG. 4. Collar **322** is locked in any conventional means onto longitudinal portion **308**.

[0069] Motor assembly **106** includes motor **156** which is connected to a common shaft **154** to roller **152** having a roller face **151**.

[0070] The reader will note that rear tire **122** is allowed to move in the lateral direction **140** which will tend to happen during rocking of bicycle **302** along the rocking arc **330**.

[0071] Typically the roller **152** has a width of approximately 5 to 9 inches and preferably approximately 6 to 7 inches which allows for lateral movement of rear tire **122** along the lateral direction **140** of approximately 2 to 3 inches in reaction to any disturbance and particularly as the bicycle is rocked along rocking arc **330**. This provides for simulation of real cycling conditions in which when the rider is standing on the pedals and is pedaling often the bicycle **302** will rock back and forth along rocking arc **330** during the pedaling motion and rear tire **122** will move laterally along the lateral direction **140** as a result.

[0072] Motor **156** is rotationally attached to frame **150** at bearings **160** as depicted in FIG. 2.

[0073] The rotation of motor **156** is limited to pivoting action due to the restriction created by the motor base plate **164** impinging upon force sensor **170** on the upper side **172** and a spring **176** on the lower side **178** of motor base plate **164**.

[0074] It should be apparent to persons skilled in the arts that various modifications and adaptations of this structure describe above are possible without departure from the spirit of the invention the scope of which is defined in the appended claim.

I claim:

1. A bicycle trainer for use with a bicycle with its front tire removed from the fork dropout, the bicycle trainer comprises:

- e) a stand which includes a flexible connecting arm connected to a motor assembly at a tire end of the flexible connecting arm;
- f) a fork end of the flexible connecting arm dimensioned to attach to the front fork dropout of a bicycle;
- g) the motor assembly includes a roller with a roller face, wherein the rear tire of the bicycle making contact with a roller face of the roller such that the roller is free to rotate in proportion to the rotation of rear tire and further the tire is free to move in a lateral direction across a portion of the face of the roller;
- h) a motor is rotationally connected to the roller for selectively applying resistance and assistance to the rear tire rotation, for simulating real course conditions.

2. The bicycle trainer claimed in claim 1 further wherein the flexible connecting arm is dimensioned and selected to allow torsional flex of the flexible connecting arm such that the bicycle will rock back and forth along a rocking arc when the rider imparts torsional forces onto the stand.

3. The bicycle trainer claimed in claim 1 wherein the motor assembly which includes a frame for housing the roller and motor and also for rigidly connecting the motor assembly to the flexible connecting arm, the motor is rotationally mounted about its shaft with limited pivotal movement to the frame, such that the motor and roller rotate in proportional unison with each other.

4. The bicycle trainer claimed in claim 3 wherein the motor assembly further includes a means for measuring force.

5. The bicycle trainer claimed in claim 4 wherein the measuring means includes a force sensor for measuring the tangential force between the roller and the rear tire.

6. The bicycle trailer claimed in claim 4, wherein the motor assembly further includes a base plate to which the motor is rigidly mounted, the base plate is free to pivot with the motor and includes a top side and bottom side.

7. The bicycle trainer claimed in claim 6 wherein the motor assembly includes a force sensor and spring, the force sensor in contact with one side of the base plate, and the spring contacting the other side of the plate such that the force sensor and spring restrict the pivoting deflection of the base plate and thereby measure the tangential force between the roller and rear tire.

8. The bicycle trainer claimed in claim 7 where the force sensor and spring are opposing each other mounted on opposite sides of the base plate, in order to maintain positive bias of force on the force sensor.

9. The bicycle trainer claimed in claim 7 wherein the force sensor is chosen from the group comprising piezo electric, and strain gauge and load cell and magneto elastic transducers.

10. The bicycle trainer claimed in claim 7 further including a controller which includes data sets for simulating real and imaginary road conditions.

11. The bicycle trainer claimed in claim 10 wherein the motor assembly in response to the controllers input imparts

resistance and assistance to tire rotation and adjusts the assistance and resistance forces imparted at least 100 times per second.

12. The bicycle trainer claimed in claim 1 wherein the flexible connecting arm includes a longitudinal portion, a support arm and a fork support, wherein the longitudinal portion connected to the motor assembly at a tire end, and connected to the support arm at the other end, and the support arm also connected to a fork support.

13. The bicycle trainer claimed in claim 12 wherein the horizontal portion adapted to flex torsionally in response to torsional force imparted onto the stand.

14. The bicycle trainer claimed in claim 1 wherein the flexible connecting arm selected to allow a rocking arc of 10° each side of centre for a total arc of 20°.

15. The bicycle trainer claimed in claim 1 wherein the flexible connecting arm selected to allow a rocking arc of 5° each side of centre for a total arc of 10°.

16. The bicycle trainer claimed in claim 1 wherein the flexible connecting arm made of an aluminium alloy 6061 having a wall thickness of 10 mm.

* * * * *