# *The Generation Four Bicycle*

## *Is this a fundamentally new type of bicycle?*
## *Only the fourth in history?*

31st International Cycling History Conference
Indianapolis, USA
July 18, 2022

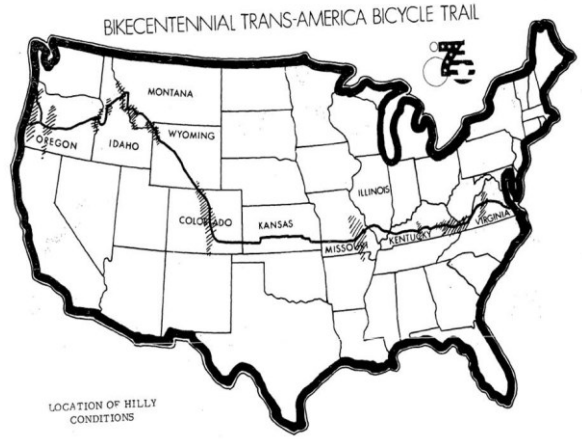
G4 Bikes

***Better Bikes***
***For***
***More People***

*Ron Thompson*
*ronaldathompson7641@gmail.com*
*Bel Air, Maryland, USA*

# *Who Am I?*


- Retired in 2014 to develop bikes!
  - Professional Engineer and Systems Analyst
  - DoD Career:  System Development, Test and Evaluation
- Conventional Bike History
  - Biked to work
  - Family, friends and vacation rides
  - Harford Velo Club - Founding Member
  - Tandem
  - Trans-Am in 2011
- Building
  - “Dream Shop” built in 2009
  - Wood, Machine, Welding, Composites, Office, Library
- Recumbent Research – I needed to understand…
  - Wanted to buy current *<u>and</u>* build new
  - Studied, traveled, shopped, tested, documented
  - First recumbent ride in 2014
  - I did not buy…
  - ***Peggy fell and was done with recumbents…***





# How to Define a "Fundamental New Type of Bicycle"

## Operationally

*Why do you want it?*

- Transportation
- Recreation
- Fitness
- Sport (?)

- Appealing
  - Practical
  - Emotional

## Functionally

*How does it work?*

- How does it provide:
  - Speed
  - Comfort
  - Safety

- Principles of Operation
  - Ergonomics & Propulsion
  - Power Transmission
  - Stability and Control
  - Aerodynamics

## Physically

*What is the configuration?*

- Generation 1
- Generation 2
- Generation 3
- Generation 4

***Rider Integration and Engagement is Critical!***

***This is also a Process of System Engineering***

# *Three Bicycle Generations Defined*

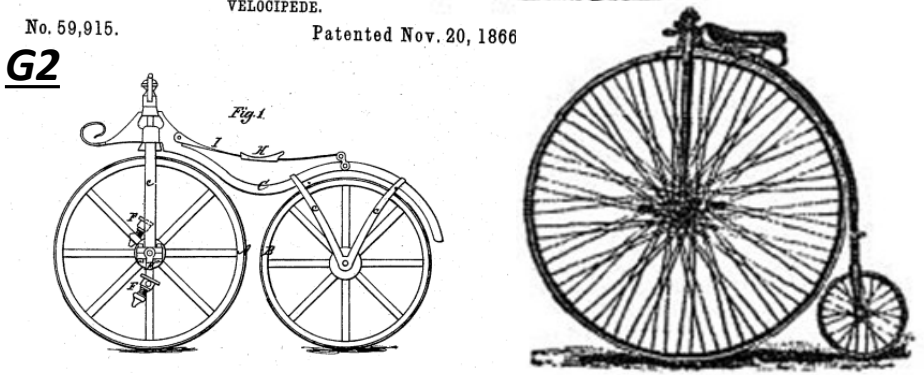
- Generation 1 - Draisene - 1818
  - Two wheels can be balanced by steering the front!
  - "Scooter" propulsion

- Generation 2 - Boneshakers and High Wheelers - Circa 1860
  - Pedal-Crank front wheel propulsion
  - Pedal force input is ~ *parallel* to the steering axis

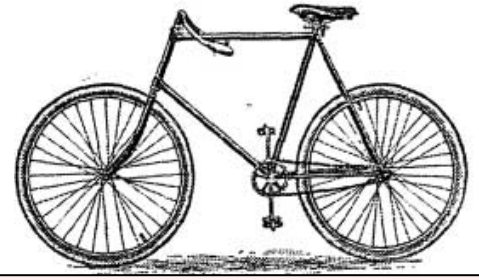
- Generation 3
  - "Safety Bike" - Circa 1885 - current ubiquitous "Upright"
  - Rear wheel drive separated steering and propulsion
  - ***Can stand, pedal and provide hand power!****

***G1***

***G2***




***G3***



**** J.K. Starley said the big G3 advantage was being able to stand and pedal!***

G3 Problems Remained:

- Seat height is still greater than leg length – Can't put feet on the ground
- Still a long way to fall – "taking a header" is still far too common
- Some find the seat uncomfortable, can be hard to mount
- Drop bar – bent over position can be uncomfortable
- Lots of frontal area and wind resistance

# A Critical G3 Advantage

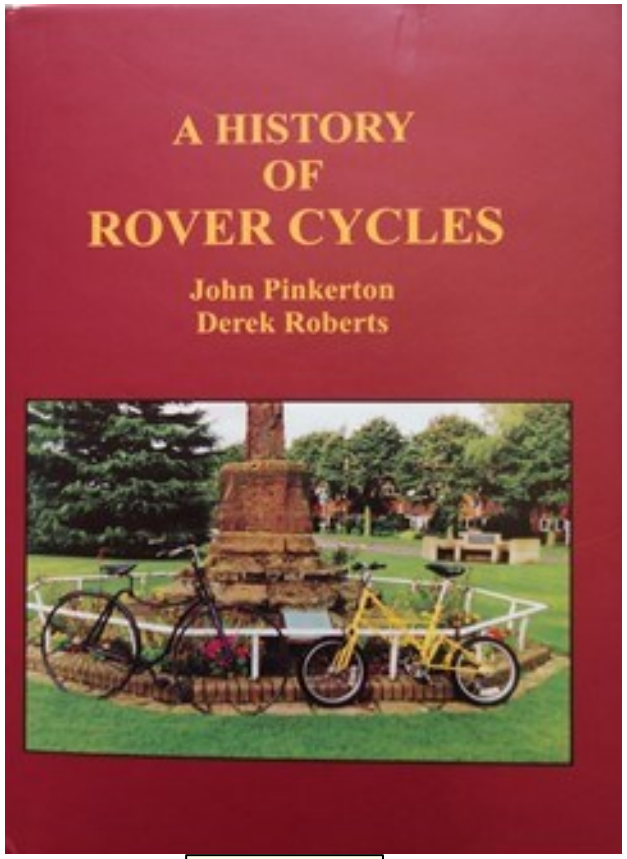
*J.K. Starley resented the idea that his Rover was simply the embodiment of safety in a bicycle, as his Letter Circa 1885, demonstrates:*

*"It is astonishing to what extent the Rover should be regarded as a rear-driven safety, and nothing more. We deem it our duty to dispel this illusion, it being very misleading.*

*The Rover is absolutely the outcome of a determination to obtain advantage previously unknown in a bicycle.*

*We felt confident that a large percentage of unused power could be utilized if the rider were properly placed, particularly with regard to hill climbing.*

*In this we were not mistaken, as the enormous success of the Rover undoubtedly proves."*




See page 36



**Standing to pedal allows full-body engagement, bursts of power, acceleration & climbing.**

# G3 Hand - Arm - Upper Body Power Input

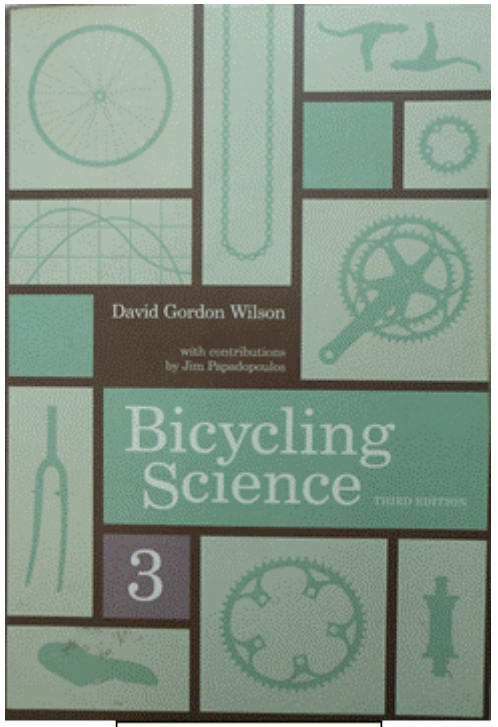
David Gordon Wilson explains:

*"Standing to pedal is familiar, but often not well understood.*

*In conventional upright bicycles …*

*Substantial arm work is easily performed by tilting the bicycle away from the descending pedal …*

*Recumbents … do not permit the rider to use additional muscles in this way."*




See Pgs. 98-99

- Absolute power is still limited by rider cardiovascular and energy systems
- Hand input allows bursts of power – particularly useful for acceleration and climbing
- Use of additional upper body muscle may also increase rider endurance

***Is this why recumbents have never achieved upright bike popularity?***

# Recumbent Bicycles

- Recumbents emerged circa 1896
- Configurations vary extensively
- Pedal force input is ~ *perpendicular* vice ~*parallel* to the steering axis
- I classify Recumbents as a *"G3 subset"*
  - Historically concurrent
  - Most are rear wheel drive
  - Have remained niche

Long Wheel Base

Recumbent Advantages:

- ***Aerodynamics***
- ***Comfort***
- ***Safety***

*For an excellent overview see, "A Complete Illustrated History of the Recumbent Bicycle" by Hadland and Lessing*

Recumbent Problems:

- ***The rider cannot stand to pedal!***
  - *Cannot engage the upper body…*
  - *Less surge power, responsiveness, acceleration and climbing*
- Crankset - front wheel conflict
  - Feet high off the ground
  - Small front wheel
  - Extended wheelbase
  - Long chain to rear wheel
- The reclined seating impedes agility for aggressive offroad mountain biking.

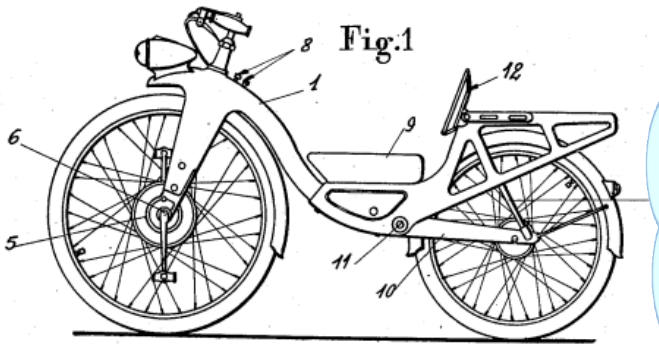
Short Wheel Base

High Racer

***Reduced Engagement and Integration of the Rider Diminishes the Ride Experience!***

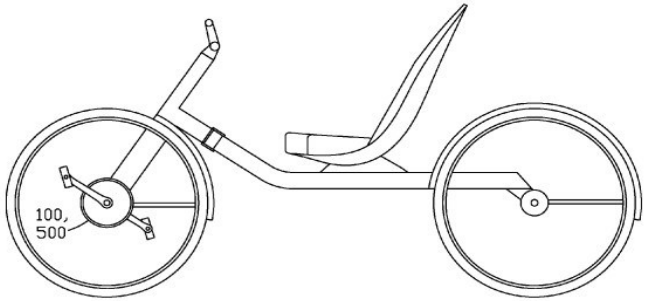
# Additional Recumbent Configurations…

April 25, 1950 L. DEBUIT 2,505,464
BICYCLE OR MOTORCYCLE CARRYING A SINGLE STEERING WHEEL AND TRANSMISSION GEARS AND CONNECTIONS THEREFOR
Filed Feb. 1, 1947 5 Sheets-Sheet 1




**Frame Mounted, Coaxial, FWD**

***Key Prior Art Objective: Coaxial crankset and multi speed front hub***




**DIRECT-DRIVE (CHAINLESS) RECUMBENT BICYCLES**
Thomas Kretschmer
Jeremy Garnet - Velotegra
Marc LaBorne – Kervelo
John Stegmann – The HUB

**Fork Mounted, Coaxial, FWD**

United States Patent [19]
Traylor

[11] Patent Number: Des. 277,744
[45] Date of Patent: ** Feb. 26, 1985

[54] BICYCLE FRAME

[76] Inventor: **Thomas D. Traylor**, 22407 Warmside, Torrance, Calif. 90505

[**] Term: **14 Years**

[21] Appl. No.: **373,996**

[22] Filed: **May 3, 1982**

[52] **U.S. Cl.** ..... **D12/111**

[58] **Field of Search** ..... D12/111; 280/261, 270, 280/281 R, 281 LP, 281 W

[56] **References Cited**
FOREIGN PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| 918778 | 11/1946 | France | 280/281 LP |
| 453687 | 9/1930 | United Kingdom | 280/281 LP |

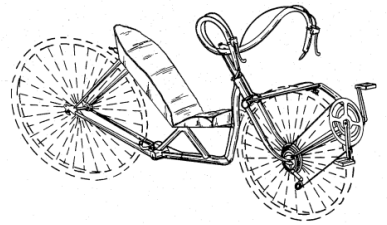
*Primary Examiner*—James M. Gandy
*Attorney, Agent, or Firm*—Singer & Singer

[57] **CLAIM**

The ornamental design for a bicycle frame, as shown and described.

**DESCRIPTION**

FIG. **1** is a perspective view illustrating the design of my bicycle frame;
FIG. **2** is a right side elevation view thereof;
FIG. **3** is a bottom plan view thereof;
FIG. **4** is a left side elevation view thereof;
FIG. **5** is a top plan view thereof;
FIG. **6** is a rear elevation view thereof; and
FIG. **7** is a front elevation view thereof.
The broken lines in the drawing are for illustrative purposes only.



**Fork Mounted, FWD**

**Frame Mounted, FWD**

United States Patent [19]
Sawyer et al.

[11] Patent Number: 4,773,663
[45] Date of Patent: Sep. 27, 1988

[54] RECUMBENT BICYCLE

[76] Inventors: **Kevin A. Sawyer**, 417 Mountain Veiw Ave., Mountain View, Calif. 94041; **Raymond A. Brindos**, 3112 Zion La., San Jose, Calif. 95132

[21] Appl. No.: **130,470**

[22] Filed: **Dec. 9, 1987**

[51] **Int. Cl.**[4] ..... **B62M 1/02**

[52] **U.S. Cl.** ..... **280/261**; 280/263; 280/274; 280/270; 280/281 LP

[58] **Field of Search** ..... 280/259, 260, 261, 263, 280/274, 270, 281 R, 281 B, 281 LP, 282

[56] **References Cited**
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|---|---|---|---|
| 1,342,688 | 6/1920 | Millward | 280/259 |
| 1,598,869 | 9/1926 | McCann | 280/259 |
| 2,482,472 | 9/1949 | Fried | 280/287 |
| 4,534,578 | 8/1985 | Keller | 280/281 B |

OTHER PUBLICATIONS

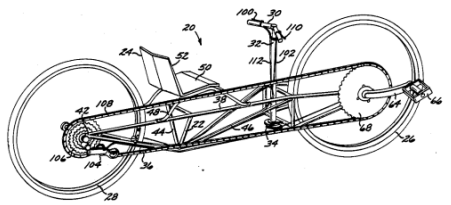
SAE Technical Paper 840021, "Evolution of Recumbent Bicycles and the Design of the Avatar Bluebell", David Gordon Wilson et al., Feb. 1984.

*Primary Examiner*—David M. Mitchell
*Assistant Examiner*—Donn McGiehan
*Attorney, Agent, or Firm*—Gregory O. Garmong

[57] **ABSTRACT**

A recumbent bicycle is powered by the driving of a crank spindle that rotates on an axis generally coincident with that of the front wheel. The crank spindle is disposed within a spindle housing supported from the front of the bicycle frame, and the spindle housing supports the front wheel through a steerably turnable intermediate hub. Steering of the handlebars causes the front wheel to turn to steer the bicycle, while the crank spindle remains in a fixed orientation to the frame so that the bicycle can be continuously driven with pedals connected to the crank spindle, which in turn is connected to the rear wheel through a sprocket and drive chain assembly.

**18 Claims, 6 Drawing Sheets**



**Frame Mounted, Coaxial, RWD**

(19) **United States**
(12) **Patent Application Publication**
**Tolhurst**

(10) **Pub. No.: US 2009/0072511 A1**
(43) **Pub. Date: Mar. 19, 2009**

(54) **FRONT WHEEL DRIVE RECUMBENT BICYCLE**

(76) Inventor: **John Irven Tolhurst**, Perth (AU)

Correspondence Address:
**Leyendecker & Lemire, LLC**
**C/O PORTFOLIO IP, P.O. BOX 52050**
**MINNEAPOLIS, MN 55402 (US)**

(21) Appl. No.: **11/857,053**

(22) Filed: **Sep. 18, 2007**

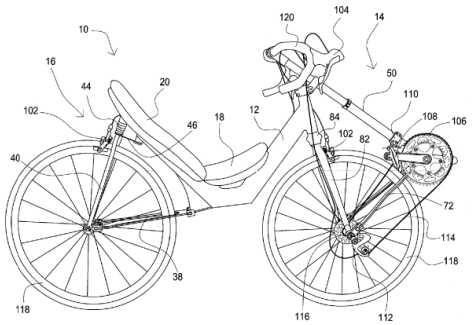
**Publication Classification**

(51) **Int. Cl.**
*B62K 3/02* (2006.01)

(52) **U.S. Cl.** ..... **280/281.1**

(57) **ABSTRACT**

Embodiments of the present invention comprise a lightweight front wheel drive recumbent road bicycle and an associated frame. A front triangle is provided to which the drive train of a standard road group can be attached and utilized. A telescoping tube assembly is provided in the front triangle to permit the distance of a bottom bracket and crankset from a seat pan to be adjusted for riders of different sizes. The handlebar is coupled to an end of the telescoping tube assembly and no traditional handlebar stem attached to a steering tube is utilized, so that the structure provides maximum stiffness to better capture the input of the arms and upper body when maximum power is required. The seat pan and a seat back are integrated with the main frame truss structure to help ensure the maximum transfer of the rider's energy to the drive train.



**Can Further Discuss as Time Permits**

# Hand and Foot Powered Recumbent Configurations

**United States Patent** [19]
**Thomas**

[11] **4,270,766**
[45] **Jun. 2, 1981**

[54] **ARM AND LEG POWERED DRIVE SYSTEM FOR A VEHICLE**

[76] Inventor: **John C. Thomas,** 1557 McKinley St., Eugene, Oreg. 97402

[21] Appl. No.: **65,458**

[22] Filed: **Aug. 10, 1979**

[51] **Int. Cl.**[3] ..... **B62M 1/12**
[52] **U.S. Cl.** ..... **280/234;** 280/236; 280/250
[58] **Field of Search** ..... 280/233, 234, 236, 238, 280/249, 250

[56] **References Cited**
U.S. PATENT DOCUMENTS

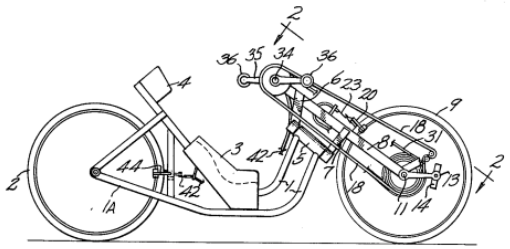
| | | | |
|---|---|---|---|
| 2,390,719 | 12/1945 | Kurth | 280/234 |
| 2,533,728 | 12/1950 | Gedat et al. | 280/233 |
| 3,193,305 | 7/1965 | Hendricks | 280/250 |
| 3,910,599 | 10/1975 | Thomas | 280/234 |

*Primary Examiner*—John J. Love
*Assistant Examiner*—Donn McGiehan
*Attorney, Agent, or Firm*—James D. Givnan, Jr

[57] **ABSTRACT**

A drive system for an operator powered vehicle utilizing both arm and leg power. Leg power drives an axle carried sprocket coupled to a torque tube via a roller chain. A hand crank is powered by arm motion and is coupled to a concentric torque tube by a unidirectional clutch. Rotary motion is accordingly imparted to the torque tube by the arms or legs, jointly or individually, which motion is transmitted to a wheel hub via a roller chain and sprocket arrangement. A chain shifter provides a variable speed power transmission between said torque tube and the wheel hub. Brake cable actuating members on the wheel axle and the hand crank permit selective tensioning of brake cables actuating front and rear wheel brakes. A modified form of the invention dispenses with the torque tube. Driving and driven sprockets of a hand crank assembly are fixedly mounted on a hand crank.

**10 Claims, 3 Drawing Figures**



**United States Patent** [19]
**Thomas**

[11] **3,910,599**
[45] **Oct. 7, 1975**

[54] **HAND AND FOOT POWERED DRIVE SYSTEM FOR A VEHICLE**

[76] Inventor: **John C. Thomas,** 2867 Harris St., Eugene, Oreg. 97405

[22] Filed: **Nov. 15, 1974**

[21] Appl. No.: **523,971**

[52] **U.S. Cl.** ..... **280/234;** 280/236; 280/264
[51] **Int. Cl.**[3] ..... **B62M 1/12**
[58] **Field of Search** ..... 280/233, 234, 236–238, 280/250, 249, 264, 232

[56] **References Cited**
UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,390,719 | 12/1945 | Kurth | 280/234 |
| 3,193,305 | 7/1965 | Hendricks | 280/250 X |

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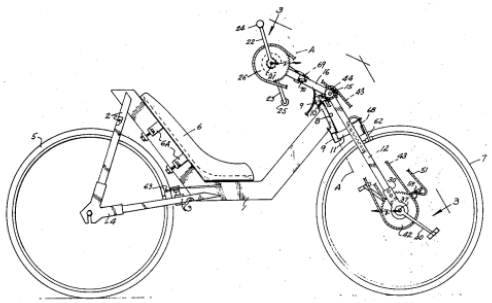
| | | | |
|---|---|---|---|
| 515,317 | 1/1939 | United Kingdom | 280/233 |
| 743,559 | 1/1933 | France | 280/234 |
| 426,044 | 3/1935 | United Kingdom | 280/250 |

*Primary Examiner*—Kenneth H. Betts
*Attorney, Agent, or Firm*—James D. Givnan, Jr.

[57] **ABSTRACT**

An operator powered vehicle with a drive system utilizing arm and leg power, jointly or separately, to drive a jackshaft which drives a sprocket equipped hub of a driving wheel. The hub and wheel are journalled for independent rotation on a live axle which also serves to mount pedal arms and a sprocket in driving connection with the jackshaft. A hand crankshaft is in like connection with the jackshaft. Clutch means permit selective idling of either the foot pedals or hand cranks or joint driving engagement of both with the jackshaft. Arm and leg powered components are offset oppositely from an upright steering axis to minimize undesired residual torque acting about said axis.

**5 Claims, 3 Drawing Figures**



(19) **United States**
(12) **Patent Application Publication** (10) **Pub. No.: US 2019/0002055 A1**
**Reed** (43) **Pub. Date: Jan. 3, 2019**

(54) **ALL LIMB POWERED AND STEERED FRONT WHEEL DRIVE LAND VEHICLE**

(71) Applicant: **Christopher Drake Reed**, Dalton, GA (US)

(72) Inventor: **Christopher Drake Reed**, Dalton, GA (US)

(21) Appl. No.: **15/635,234**

(22) Filed: **Jun. 28, 2017**

**Publication Classification**

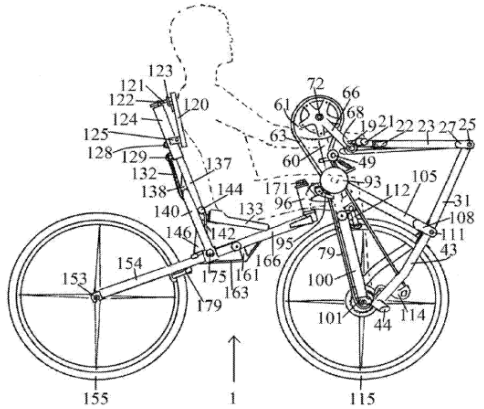
(51) **Int. Cl.**

| | |
|---|---|
| ***B62M 1/12*** | (2006.01) |
| ***B62J 1/00*** | (2006.01) |
| ***B62K 5/02*** | (2006.01) |
| ***B62K 3/00*** | (2006.01) |
| ***B62M 1/36*** | (2006.01) |
| ***B62M 3/06*** | (2006.01) |
| ***B62M 9/00*** | (2006.01) |

(52) **U.S. Cl.**
CPC ..... ***B62M 1/12*** (2013.01); ***B62J 1/00*** (2013.01); ***B62K 5/02*** (2013.01); ***B62M 2009/002*** (2013.01); ***B62M 1/36*** (2013.01); ***B62M 3/06*** (2013.01); ***B62M 9/00*** (2013.01); ***B62K 3/005*** (2013.01)

(57) **ABSTRACT**

An all limb powered and steered front wheel drive land vehicle comprises a seat (**133**), a front wheel (**115**), a rear wheel (**155**), a front drive component (**66**) and a frame (**1**) wherein; the seat (**133**) and a rear wheel (**155**) are mounted on a rear portion of the frame (**1**); wherein the front wheel (**115**) and front drive component (**66**) are mounted on a front portion of the frame (**1**); wherein the front drive component (**66**) comprises a drive mechanism (**61**) for driving the front wheel (**115**) and a connecting rod (**23**)comprising two hand grips for driving the drive mechanism (**61**) and a lever (**31**) comprising two foot pegs for driving the connecting rod (**23**) and a fulcrum (**105**) mounting the lever (**31**) to the frame (**1**). Employing all four limbs of a comfortably seated rider for power and steering, this high performance bicycle converts into a tricycle by removing the rear wheel (**155**) and replacing it with an axle (**192**) and a left rear wheel (**190**) and a right rear wheel (**191**).



***Many patents indicate that there is a need for recumbent hand power!***

***These mechanisms allow more than the necessary "Supplemental" hand power input.***

***Additional Mechanism Adds Complexity and Cost; Constant Burdon but Intermittent Utility***

***Has the UCI Ban resulted in optimization of the wrong bicycle configuration?***

# *Bicycle Racing Impact on Recumbent Development*

- In 1933 Francis Faure, on Charles Mochet's, "Vélocar" established a new hour world record of 27.996 miles
- In 1934 the Union Cycliste Internationale (UCI) banned recumbent bicycles
  - To emphasize human aspect of the sport?
- Effectively stifled *commercial* development of recumbents
- Also stifled *technical* development of recumbents
- Upright bicycles have remained ubiquitous
- Upright bicycles have become highly optimized

***Could the recumbent be a better bicycle configuration for most people?***

# ~Six G4 "Developmental Prototype" Bikes


P-1

P-2

P-3

*Serendipity…*

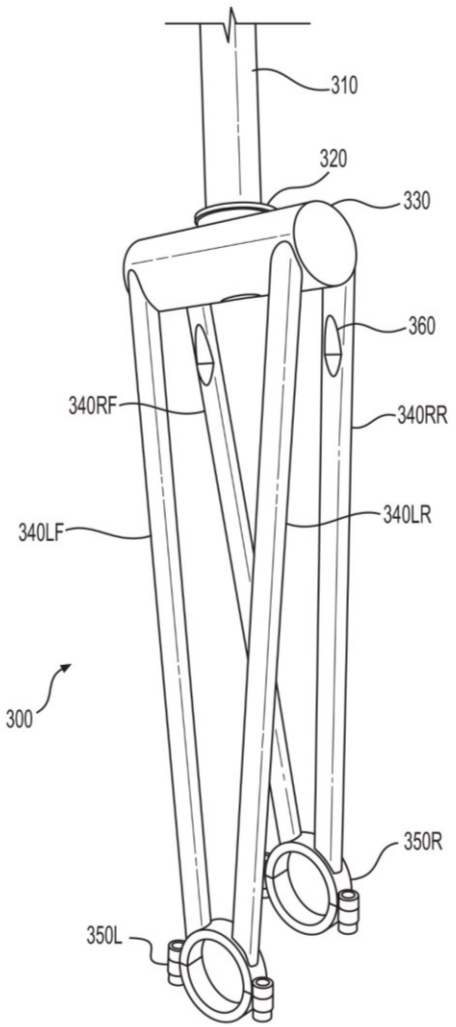

- Started building in 2014
- Objectives
  - Practical, "Road Touring"
  - Speed, comfort, & safety
  - Fairings
    - Speed & Efficiency
    - Protection (Weather & Injury!)
    - Cargo
- P1 - Spring 2015 – ***Manage PFF!***
- P2 - Spring 2016 – ***Manage PFF??***
- P3 - Spring 2018 – ***Hand Power!***
- P4 - Spring 2019 - *Refinements*
- P5 - Spring 2020 – *Peggy's Bike*
- *P6 - Spring 2022 – Race Bike*

P-4


P-5


P-6

# The Generation Four Bicycle




- Front wheel driven and steered
- Crankset is mounted on the fork and located near the steering axis
- A “Hand over Foot” Leverage Ratio lets weaker hands control stronger foot forces
  - Ratio used is ~1.8-2.4 to 1
  - Fulcrum is the Steering Axis
  - Upright Bike uses tire-ground contact points
- Double Triangulated Fork - Rigid in torsion to hand and foot forces in applied in opposition
- Low step over, both feet easily touch ground, head up position, intermediate wheelbase, rider centered for balanced handling & smooth ride.

***Hand power is added by pulling the crankset into the pedal thrust.***

***No supplemental mechanism needed.***

(12) **United States Patent**
**Thompson**

(10) **Patent No.: US 11,142,274 B1**
(45) **Date of Patent: Oct. 12, 2021**

(54) **RECUMBENT BICYCLE AND METHODS OF RIDING EMPLOYING SUPPLEMENTAL UPPER BODY POWER, ENHANCED AERODYNAMICS, STABILITY, AND CONTROL**

(71) Applicant: **Ronald Alan Thompson**, Bel Air, MD (US)

(72) Inventor: **Ronald Alan Thompson**, Bel Air, MD (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 109 days.

(21) Appl. No.: **16/238,744**

(22) Filed: **Jan. 3, 2019**

(51) **Int. Cl.**

| | |
|---|---|
| ***B62K 3/00*** | (2006.01) |
| ***B62K 3/02*** | (2006.01) |
| ***B62J 17/02*** | (2006.01) |
| ***B62J 1/28*** | (2006.01) |
| ***B62L 3/02*** | (2006.01) |
| ***B62M 9/00*** | (2006.01) |
| ***B62K 21/04*** | (2006.01) |
| ***B62K 21/02*** | (2006.01) |

(52) **U.S. Cl.**
CPC ..... ***B62K 3/005*** (2013.01); ***B62J 1/28*** (2013.01); ***B62J 17/02*** (2013.01); ***B62K 3/02*** (2013.01); ***B62K 21/02*** (2013.01); ***B62K 21/04*** (2013.01); *B62L 3/02* (2013.01); *B62M 9/00* (2013.01)

(58) **Field of Classification Search**
CPC ..... B62K 3/005; B62K 3/02; B62K 21/02; B62K 9/00; B62K 21/04; B62J 1/28; B62J 17/02; B62L 3/02; B62M 9/00
See application file for complete search history.

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DE 102004019621 A1 * 11/2005 ..... B62K 3/005

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Thomas Kretschmer, Direct Drive (Chainless) Recumbent Bicycles, Human Power, No. 49, winter 1999-2000, pp. 11-14.

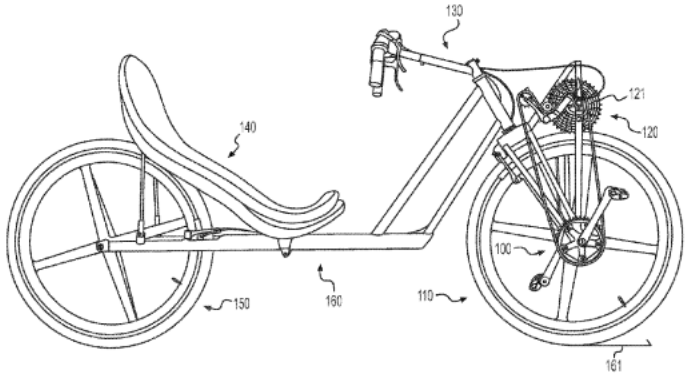
(Continued)

*Primary Examiner* — Christopher R Harmon
(74) *Attorney, Agent, or Firm* — Boudwin Intellectual Property; Daniel Boudwin

(57) **ABSTRACT**

Disclosed is a recumbent bicycle configuration, structure and methods which allow effective hand power input using only components otherwise required to pedal and steer. Force and work based hand power methods are used. The effect is comparable to standing and pedaling a conventional bicycle. The configuration has front wheel drive and steering. The crankset is fork mounted on or near the steering axis. The fork has a double triangulated torque tube structure which is rigid from the hand grips to the crankshaft end-points to torsional hand and foot forces in opposition. Pedal forces on steering are controlled by a hand over foot leverage ratio, and by use of trail, which is increasingly effective with speed. A fork mounted fairing can be used. For stability, the fairing aerodynamic center of presented area is ahead of the steering axis. Hand, foot and selective braking inputs are used for enhanced control.

**14 Claims, 8 Drawing Sheets**




***G4 = Upright Hand Power Input + Recumbent Aero Efficiency, Comfort and Safety + …***

# *The G4 Bicycle*

## Aerodynamic Stability and Control

- Front fork assembly aerodynamic "Center of Pressure" is located ahead of the steering axis to provide "self correcting stability" to wind gusts.
- Hand and foot inputs provide powerful, continuous, steering control.

***Allows routine use of an aerodynamic disk front wheel.***

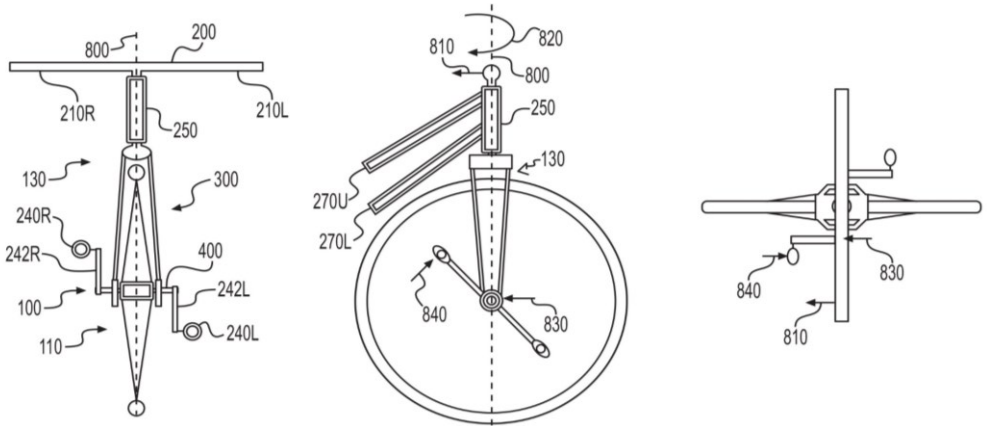
## Method of Riding

- Balanced hand ***reaction*** allows efficient foot pedal input.
- Excess hand ***force*** input causes crankshaft lateral pressure on the crankarm, directed in opposition to pedal pressure, thereby increasing ***crankshaft torque***.
- Hand ***motion*** adds torque and ***work*** by reducing the foot perimeter distance traveled.

***Empirically, hand input may add power bursts of ~50%.***

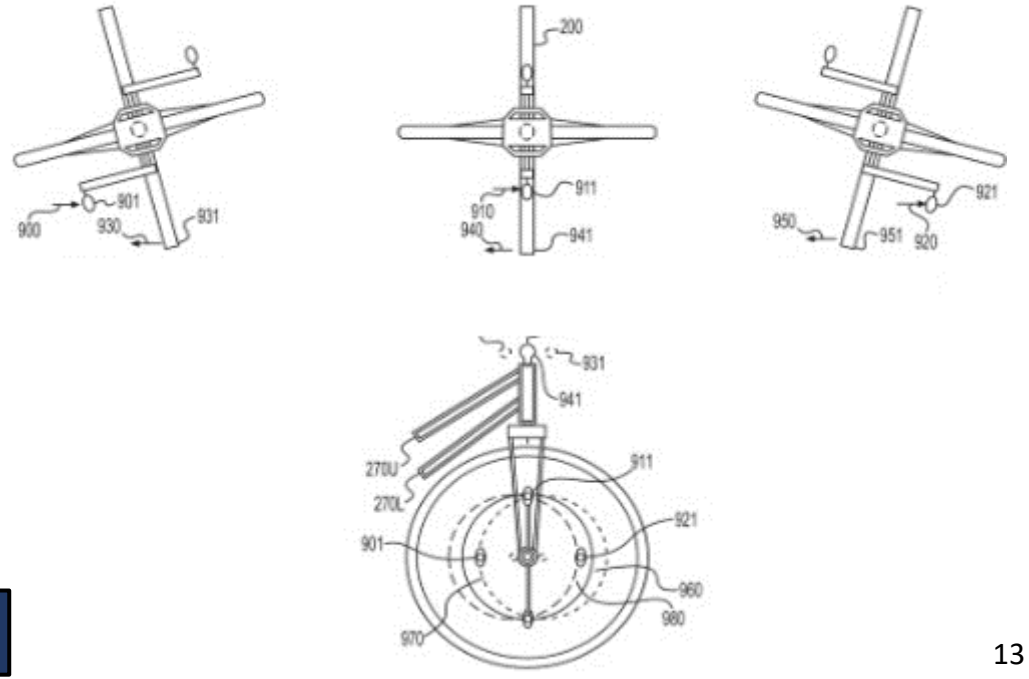
***G4 = Upright Power + Aero, comfort, safety + Stability and Control!***

## *Hand Torque Input to Crankshaft*




***These are new principles of operation***

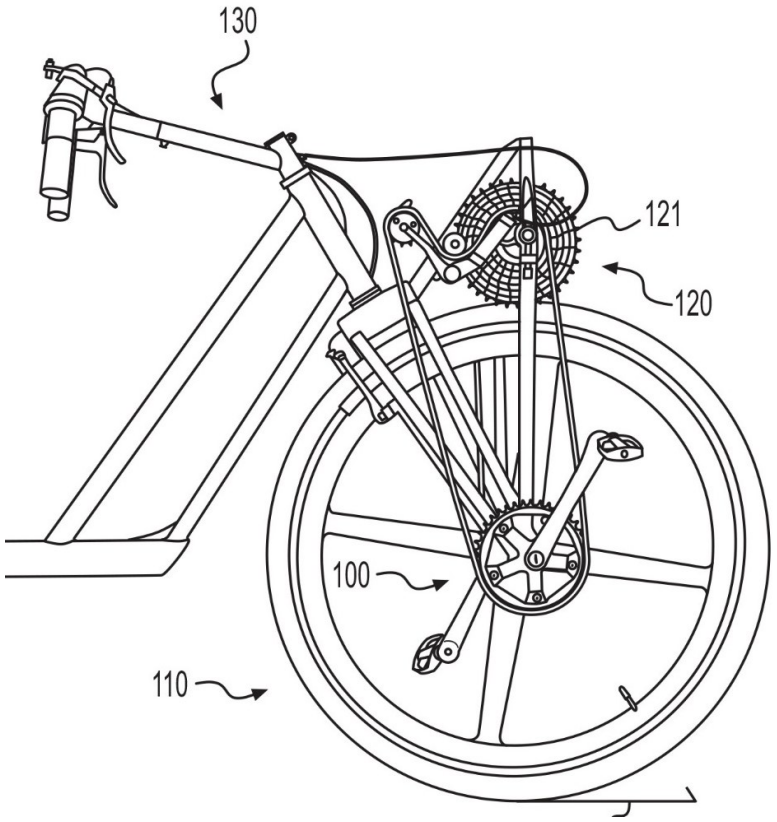
## *Hand Torque and "Work" Input*

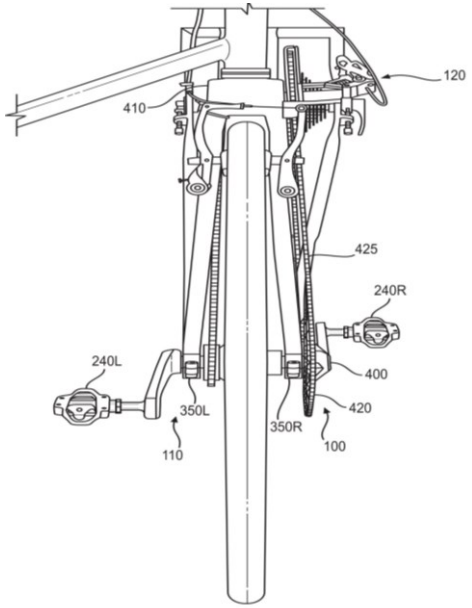


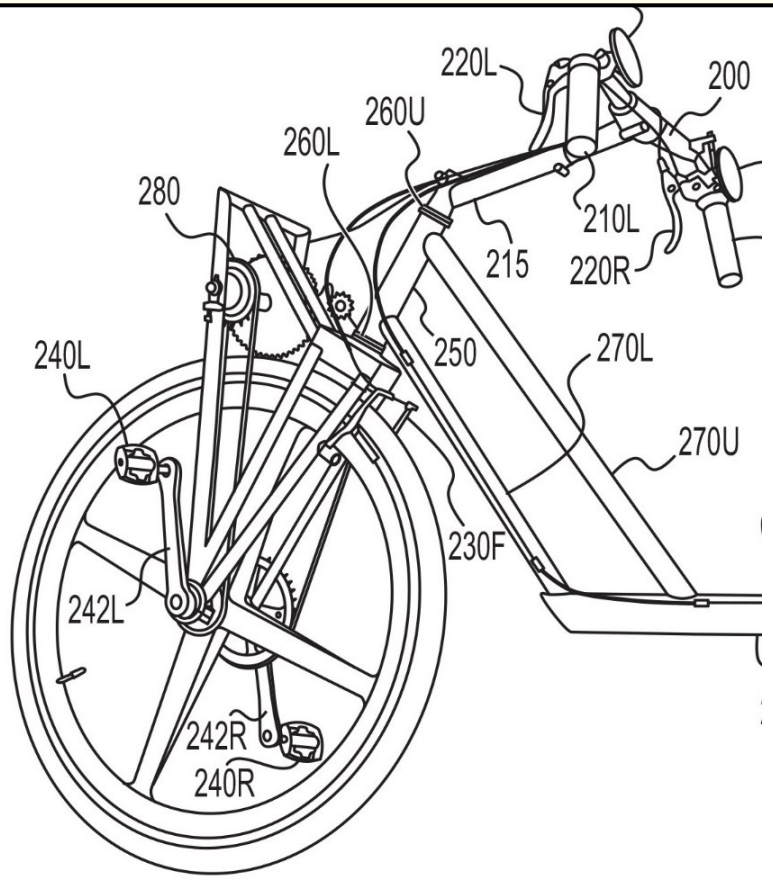
# *G4 "Road Sport"*

- The coaxial crankshaft and front wheel rotate independently.
- Chain 1 provides pedal input to the secondary shaft.
- Secondary shaft carries multi-speed transmission.
- Chain 2 drives the front wheel at transmission output speed.

- ***G4 Hand Power May be More Effective than an Upright.***
  - *Rider remains seated*
  - *Power can be applied immediately*
  - *Steering axis forms a more efficient fulcrum*



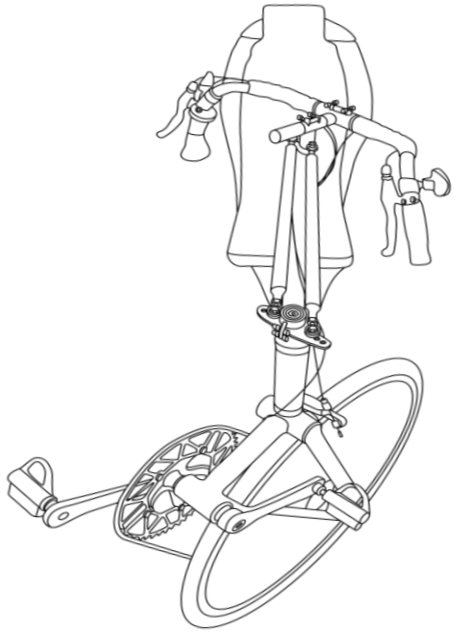



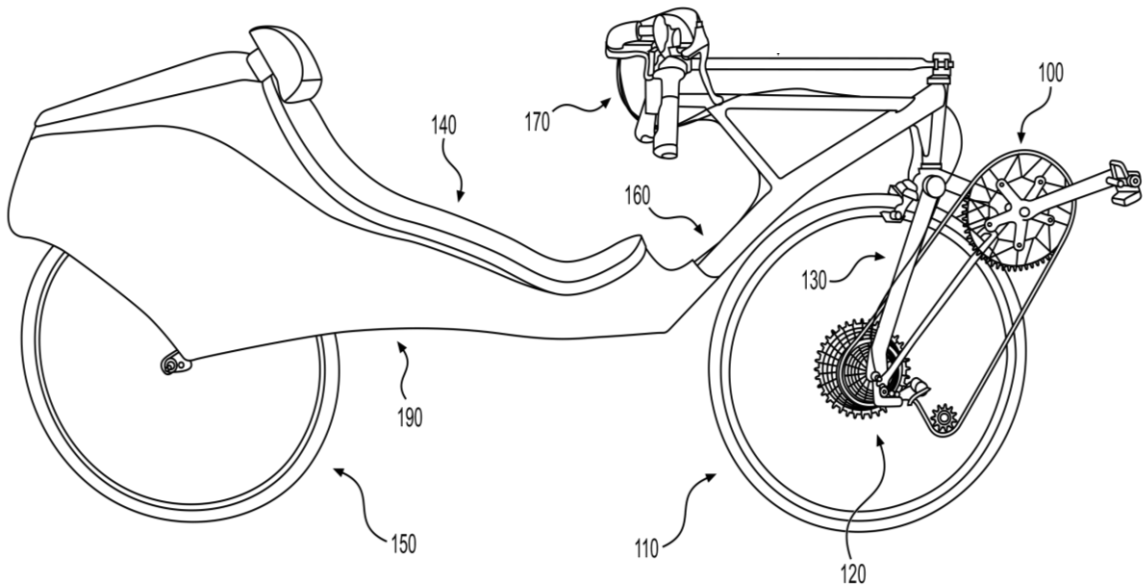



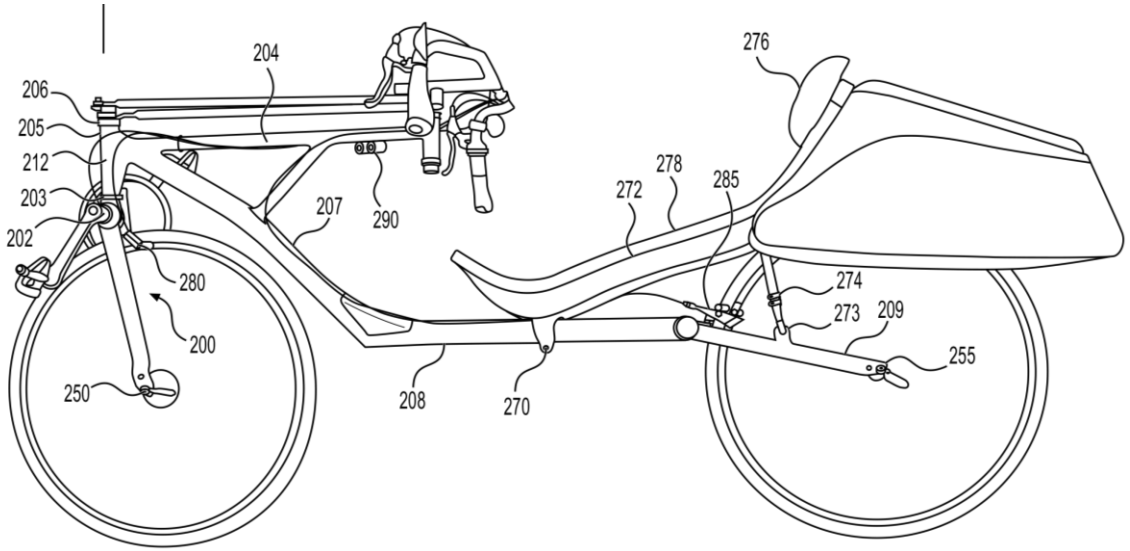

***Dual-Chain Drive is an Alternative to Development of the Complex Coaxial-Crankset-Gear-Hub!***

# *G4 "Road Race"*

- Elevated pedals and reclined seat: → Aerodynamics
- Elevated pedals: → Efficient Single Chain
- Indirect Steering & Vertical Axis: → Hand Power
- Vertical Steering Axis: → Low Speed Stability
  Reduced Wheelbase
- Crankset on the Steering Axis: → Hand Power
- Limit Offset (< Crank Arm Length): → Hand Power
  Prevent Frame Contact
  More Foot Force Control





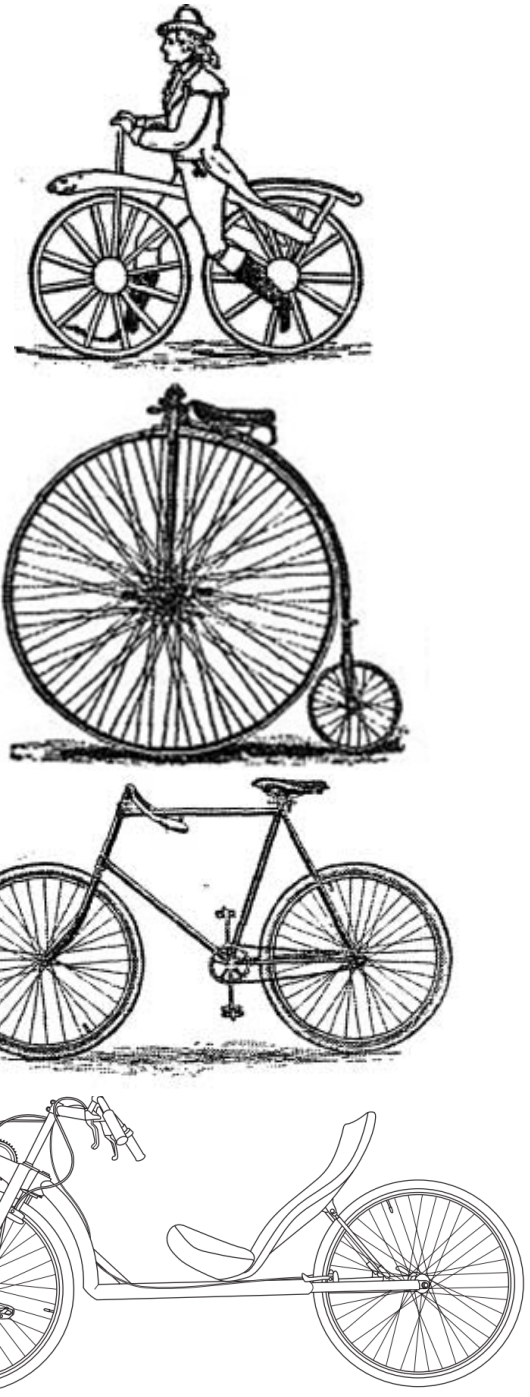






*US Patent Pending, "Recumbent Bicycle With Power Input Analogous to Standing to Pedal an Upright Bicycle"*

# *Conclusion*

- *The G4 is a Fundamentally New Bicycle*
- *Previous bicycles can be categorized into 3 generations*
- *The G4 Bike provides the best of Uprights and Recumbents*
  - *Allows the seated rider to immediately apply substantial supplemental hand power as when standing to pedal a conventional upright*
  - *Provides the aerodynamic efficiency/speed, comfort and safety of the best recumbent configurations*
  - *Unique stability and control allows routine use of a front disk wheel and fairings*



***G4 Bikes Integrate and Engage the Rider for a Superior Bicycling Riding Experience!***

# What's Next?

- Riding the G4 is great fun.
- We have ridden a total of about 30,000 miles so far.
- People see it, they ask to buy one.
- I am sorry to have to tell people they are not available.
- I think the G4 could ultimately sell in upright bike quantities.
- Making it available commercially will take a team…
- Continue "G4 System" development
  - Composite frames, forks and fairings
  - Sport, Race, Folding Travel and Trike variants
  - Aerodynamics and Sailing
  - More…
- Continue to enjoy riding!

**Can the G4 become the next mainstream bicycle?**

***Gravel***

***Road Sport***

***Road Race***

# *Summary & Questions?*

Current bikes are not the right machines for what I want to do.

Development has been constrained by professional racing organization.

I want speed, efficiency, comfort and safety, full body engagement, integration and high-performance.


I want a practical, appealing, machine for transportation, recreation and fitness.

Even if it is different.

Sometimes different is better.

The G4 is a better bicycle for people like me.

In this respect, I don't think I'm unusual.

***The world is better when more people ride bikes.***

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