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- with international search report
- with amended claims

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: HYBRID MOTORBIKE POWERED BY MUSCLE POWER AND AN ELECTRIC MOTOR WITH THE CURRENT GENERATED BY A FUEL CELL

(57) Abstract: A hybrid motorbike is provided which is powered by human muscle power on pedals and supplemented by an electric motor with the current generated by a fuel cell on the motorbike. The rear wheel is connected to a planetary-gear train which allows both the supply of muscle power and power from the electric motor. The planetary gear has a sun wheel driven by the electric motor, and a crown gear driven by muscle power, and a planetary-gear carrier having a power take-off to the drive wheel of the bike. The fuel cell and a battery and controls may be contained in an exchangeable module in the triangular space formed in the frame of the bike between the front wheel and seat. The bike has sensors to determine the speed and load placed on the pedals which is transmitted to a microprocessor programmed to control the electric motor according to the load on the pedals and the speed to be provided the desired assistance to pedaling.



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TITLE OF THE INVENTION

HYBRID MOTORBIKE POWERED BY MUSCLE POWER AND AN ELECTRIC MOTOR WITH THE CURRENT GENERATED BY A FUEL CELL

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a bicycle or motorbike which has a hybrid propulsion system of muscle power and an electric motor supplied with current generated by a fuel cell. The fuel cell and battery and controls may be contained in module that fits in the triangular space formed by the frame of the bicycle between the front wheel of the bicycle and the seat.

Description of the Prior Art

U. S. Patent No. 5,242,335 (*Kutter*) ('335), which is hereby incorporated by reference and is attached as an appendix to this application, discloses a bicycle driven by muscle power and an electric motor. This patent discloses a unique planetary-gear train on the drive wheel for utilizing both the power of an electric motor and muscle power.

U.S. Patent No. 6,286,616 (*Kutter*) ('616), which is incorporated by reference and is attached hereto as an appendix, discloses a hybrid motorbike with an electric motor which has a rotor and a stator in the drive wheel for utilizing both muscle power and electric power.

SUMMARY OF THE INVENTION

This invention provides a fuel cell for producing electricity to drive an electric motor powering a drive wheel of a two wheel vehicle, such as a motorbike or bicycle. The fuel cell and battery and controls for controlling the fuel cell and the electric motor can be placed in a module in the triangular opening formed by the frame of the bicycle between the front wheel and the rider's seat. This allows for easy replacement of the fuel cells and battery. Fuel cells will supply current to the electric motor that

The combination of the fuel cell and battery to supply current for the electric motor can be used with any hybrid motorbike that has a mechanism for utilizing both muscle power and power supplied by an electric motor. For example, this can be used with a planetary-gear train on the drive wheel as disclosed in the '335 patent. It can also be used where the electric motor is incorporated in the hub of the drive wheel supplied through the rotor and stator by the electric motor and muscle power as disclosed in the '616 patent.

BRIEF DESCRIPTION OF THE DRAWINGS

Many aspects of the invention can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present invention. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

FIG. 1 is a photograph of a motorbike of this invention being displayed by a gentleman.

FIG. 2 is a photograph of a part of the rear wheel and the fuel tank module for the fuel cell.

FIG. 3 is a photograph of the motorbike of this invention with the cover removed from the power module on one side.

FIG. 4 is a photograph of the electric motor used to partially power the motorbike of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The embodiment shown in FIG. 1 shows a motorbike with a hybrid propulsion system. The hybrid motorbike 110 has a conventional frame and wheels with a front wheel 112, and a rear wheel 114 to which power is supplied. The motorbike has pedals 116 for supplying muscle power from the rider through a conventional gear on the pedal crank to which a pedal drive chain 118 is connected.

The frame of the bicycle has a bottom front fork 120 and a top front fork 122 which are supported and reinforced by a back connecting base 124. A power module 126 is supported in the triangular space formed by 120, 122, and 124. This power

module 126 can be attached to the frame of the bicycle by any conventional means, such as bolts, which permit easy removal and installation. This bicycle has an electric motor 156 which is located immediately back of the back connecting base 124. A plastic motor drive belt 130 with teeth drives the rear wheel 114 of the motorbike. This motorbike has a seat 126 for the rider.

This motorbike 110 has a planetary-gear train 132. This planetary-gear train 132 is very similar to the planetary-gear train shown in FIG. 1 of the '335 patent. The crown gear (6) as shown in FIG. 1 of the '335 patent is driven by the pedal drive chain 118. The sun wheel (3) is driven by the motor drive belt 130. The planetary-gear train 132 allows both the supply of muscle power and power from the electric motor to be used in a complementary fashion.

This motorbike 110 is partially powered by one or more fuel cells 150 which operate on hydrogen. The hydrogen fuel tanks 134 are supported in a fuel tank module 146 attached to the rear of the bike. This fuel tank module 146 has a handle 148 for easy removal for exchange for a new module. This module 146 includes two hydrogen fuel tanks 134.

The hydrogen fuel tanks can store the hydrogen in the form of a hydrogen carbide, such as iron carbide, at relatively low pressure. These tanks 134 can be used to refuel from any convenient hydrogen source. It should be realized that high pressure hydrogen tanks may also be used.

The power module 126 is shown in FIG. 3. It includes several batteries 142 and a stack of fuel cells 150 as shown in FIG. 3. There may be controls for starting and stopping the fuel cells 150. The power module 126 can also include controls for turning the electric motor on and off. The power module 126 can be attached to the back connecting base 124, top front fork 122 or the bottom front fork 120. When the battery or fuel cell expires or fails to operate, the entire module can be replaced. While the power module is the most convenient way to carry the fuel cells 150, it should be realized that the fuel cell or cells and the battery can be mounted on the bike without the use of a power module. The current produced by the fuel cells 150 is transmitted to the twenty-four volt electric motor 156 with any supplemental power used to charge the battery. A regulator, (not shown) can be used to control the distribution of current to the battery and to the electric motor 156 as desired. The electric motor 156 is encased in a case 128 which is attached to the frame of the bike.

Controls can also be provided to automatically turn the fuel, cells on and off in order to conserve fuel. This feature is not shown in the figures.

5 The fuel cells used in this invention use hydrogen from the hydrogen fuel tanks 134 and obtain oxygen from the air. The hydrogen can be pumped by pump 152 to the fuel cell. Air can be pumped to the fuel cells by air pump 154. The hydrogen and oxygen are combined in the fuel cell 142 to produce electricity with water vapor being the by-product. Since only water vapor is a by-product, no pollution of the atmosphere occurs in the use of this invention. While it is preferred
10 that the fuel cell operate on hydrogen and oxygen, it should be realized that other types of fuel cells that produce electricity could be used as well. In the case of a fuel cell that uses hydrogen and oxygen, the oxygen is obtained from the atmosphere. Suitable wiring connects the electric controls the battery to the electric motor. The electric motor 156 has a motor gear drive 144 to which the motor drive
15 belt 130 is engaged. This electric motor can be a brushless d.c motor or other type of DC motor. This invention is not limited to a DC motor as other types of motors can be utilized by converting the current from the fuel cell to AC.

This motorbike is extremely efficient in that testing of the motorbike has confirmed that only 45 grams of hydrogen is needed to assist in powering the
20 motorbike a distance of 125 kilometers.

The battery, or batteries, 142 can be a nickel cadmium battery or a long lasting lithium battery.

It should be pointed out that because of the small amount of hydrogen that is used, it is possible to use a small hydrogen generating unit in the home or garage to
25 generate the hydrogen to fill the tanks. The hydrogen could be generated by electrolysis of water. Alternatively, it could be generated by a reformer of a mixture of methanol and water.

The battery used in this motorbike can be a 12 or 24 volt battery.

The turning of the motor on and off or to regulate its speed to assist in
30 powering the bike can be controlled by software that determines the load on the pedals and their rpm to either supply power from the electric motor or not and how much power to supply. This microcomputer can be housed in the power module or with the electric motor to use this software. A manual control can override the software in determining when the motor is turned on or off.

Other systems, methods, features, and advantages of the present invention will be or become apparent to one with skill in the art upon examination of the following drawings and detailed description. It is intended that all such additional systems, methods, features, and advantages be included within this description, be within the scope of the present invention, and be protected by the accompanying claims.

CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

1. A two wheel motor vehicle powered at least in part by a fuel cell comprising:
 - a vehicle frame supporting at least one front wheel and one back wheel and a seat, said frame forming an opening between the wheels for the placement and attachment to the frame of a power module;
 - a front axle supporting any front wheel;
 - a rear axle supporting any rear wheel;
 - a power module, said module including a fuel cell, battery, and control means for controlling the power to a wheel of the vehicle;
 - a fuel tank;
 - means for detachably attaching the power module to the frame;
 - and an electric motor for powering a wheel of the vehicle.
2. The fuel cell powered vehicle of claim 1, in which the opening in the frame between the wheels is triangular in shape.
3. The fuel cell powered vehicle of claim 1, in which the vehicle has a hybrid power system consisting of an electric motor and a mechanical power source supplied by a person.
4. The fuel cell powered vehicle of claim 2, in which the vehicle has a hybrid power system consisting of an electric motor and a mechanical power source supplied by a person.
5. The fuel cell powered vehicle of claim 1, in which the fuel cell is designed to produce electricity from hydrogen and oxygen with oxygen obtained from the atmosphere and the hydrogen obtained from the fuel tank.

6. The fuel cell powered vehicle of claim 5, in which the hydrogen is stored in the fuel tank as a hydrogen carbide.

7. The fuel cell powered vehicle of claim 6, in which the carbide is an iron carbide.

8. The fuel cell powered vehicle of claim 3, in which the mechanical power is mechanically transmitted by a person to the wheel of the vehicle being driven by pedals attached to a gear which is interconnected to a gear on the wheel being driven by a chain.

9. A two wheel motor vehicle with hybrid propulsion system for driving a drive wheel comprising:

- a vehicle frame supporting a front wheel and a back wheel and a seat;
- a front axle supporting the front wheel;
- a rear axle supporting the rear wheel;
- a pedal crank;

said vehicle having a fuel tank, a fuel cell for generating electricity, a battery, and an electric motor for powering a drive wheel and controls for the fuel cell and electric motor;

said electric motor having a rotor and a stator forming a first propulsion source with a first rotation per minute(rpm) and a first torque, and a second propulsion source with a second rpm and a second torque, with the stator of the electric motor rotatably arranged on one of an axle and a shaft of a drive train between the pedal crank and the drive wheel which can be mechanically connected with the second propulsion source so that the stator is driven by the second propulsion source, and the rotor of the electric motor having a rotational speed that corresponds to a sum of the first rpm of the first propulsion system and the second rpm of the second propulsion system.

10. The two wheel vehicle of claim 9, in which the fuel cell generates electricity from oxygen and hydrogen and the fuel tank is designed to contain hydrogen.

11. The two wheel vehicle of claim 9, in which there is a control to regulate the fuel cell and a control to regulate the speed of the electric motor.
12. The two wheel vehicle of claim 9, wherein the second propulsion source is a muscle powered propulsion system.
13. The two wheel vehicle of claim 9, in which the vehicle is a bicycle.
14. A two wheel motor vehicle with a hybrid propulsion system for driving a drive wheel comprising:
 - a vehicle frame supporting a front wheel and a back wheel and a seat;
 - a front axle supporting the front wheel;
 - a rear axle supporting the rear wheel;
 - a pedal crank for supplying muscle power;
 - said vehicle having a fuel tank, a fuel cell for generating electricity, a battery, and an electric motor for powering a drive wheel and controls for the fuel cell and electric motor; and
 - said drive wheel having a planetary-gear train having sun wheel (3) driven by an electric motor, a crown gear (6) driven by said muscle power, and a planetary-gear carrier (5) of the driven wheel 114 of the hybrid drive vehicle, said planetary-gear carrier (5) providing a power take-off to the drive wheel 114.
15. The two wheel vehicle of claim 14, in which the fuel cell generates electricity from oxygen and hydrogen and the fuel tank is designed to contain hydrogen.
16. The two wheel vehicle of claim 14, in which there is a control to regulate the fuel cell and a control to regulate the speed of the electric motor.
17. The two wheel vehicle of claim 14, in which the vehicle is a bicycle.

18. A two wheel motor vehicle of claim powered at least in part by a fuel cell comprising:

a vehicle frame supporting at least one front wheel and one back wheel and a seat, said frame forming an opening between the wheels for the placement and attachment to the frame of a power module;

a front axle supporting any front wheel;

a rear axle supporting any rear wheel;

a pedal crank powered by muscle power;

a power module, said module including a fuel cell, battery, and control means for controlling the power to a wheel of the vehicle;

a fuel tank;

means for detachably attaching the power module to the frame;

an electric motor for powering a drive wheel of the vehicle;

said drive wheel having a planetary-gear train having sun wheel (3) driven by an electric motor, a crown gear (6) driven by said muscle power, and a planetary-gear carrier (5) of the driven wheel 114 of the hybrid drive vehicle, said planetary-gear carrier (5) providing a power take-off to the drive wheel 114.

19. The two wheel vehicle of claim 9, in which the fuel cell generates electricity from oxygen and hydrogen and the fuel tank is designed to contain hydrogen.

20. The two wheel vehicle of claim 9, in which there is a control to regulate the fuel cell and a control to regulate the speed of the electric motor.

21. The two wheel vehicle of claim 18, in which said opening between the wheels is triangular in shape defined by a top front fork (122) a bottom front fork (120) and a back connecting base (124).

22. The two wheel motor vehicle of claim 18, in which the electric motor drives a sun wheel (3) by a chain, and the crown gear (6) is driven by a chain attached to a gear on the pedal crank which is driven by muscle power.

23. The two wheel motor vehicle of claim 22, in which the electric motor drives a sun wheel (3) by a chain, and the crown gear (6) is driven by a chain attached to a gear on the pedal crank which is driven by muscle power.

24. The fuel cell powered vehicle of claim 18, in which the fuel cell is designed to produce electricity from hydrogen and oxygen with the oxygen obtained from the atmosphere and the hydrogen obtained from the fuel tank.

25. The fuel cell powered vehicle of claim 18, in which the hydrogen is stored in the fuel tank as a hydrogen carbide.

26. The fuel cell powered vehicle of claim 25, in which the carbide is an iron carbide.

27. The fuel cell powered vehicle of claim 18, which has sensors to determine the speed of and load placed on the pedals and transmit this information to a microprocessor in the vehicle which has been programmed to control the speed of the electric motor according to the load on the pedals and their speed so as to provide the desired assistance in pedaling the vehicle.

AMENDED CLAIMS

[received by the International Bureau on 23 January 2006 (23.01.2006);
original claims 1-27 replaced by amended claims 1-14]

Therefore, having thus described the invention, at least the following is claimed:

1. A two wheel motor vehicle (110) powered by a hybrid power system consisting of an electric motor (156) and a mechanical power source supplied by a person comprising:

a vehicle frame supporting a front wheel (112) and a rear wheel (114) and a seat (136), said frame forming a triangular shaped opening between the wheels (112,114) for the placement and attachment to the frame of a power module (126);

a front axle supporting a front wheel (112)

a rear axle supporting a rear wheel (114);

a power module (126), said module including a fuel cell (150), battery (142), and control means for controlling the power delivered to the rear wheel (114) of the vehicle (110),

a fuel tank (134);

means for detachably attaching the power module (126) to the frame (120, 122, 124);

pedals (116) attached to a gear which is interconnected to a gear on the rear wheel (114) of the vehicle (110) by a pedal drive chain (118) for transmitting mechanical power supplied by a person;

an electric motor (156) with a motor drive gear (144) for powering the rear wheel (114) of the vehicle; and

a motor drive belt (130) attached to the motor drive gear (144) of the electric motor (156) and interconnected to a gear on the rear wheel (114) of the vehicle (110).

2. The vehicle of claim 1 in which the fuel tank (134) is capable of storing hydrogen gas.

3. The vehicle of claim 1, in which the fuel tank (134) is capable of storing hydrogen as hydrogen carbide.

4. The vehicle of claim 3, in which the carbide is an iron carbide.

5. The vehicle of claim 1 in which the pedal drive chain (118) is interconnected to one gear on the rear wheel (114) of the vehicle (110) and the motor drive belt (130) is interconnected to another gear on the rear wheel (114) of the vehicle (110).

6. A two wheel motor vehicle (110) with hybrid propulsion system for driving a drive wheel (114) comprising:

a vehicle frame supporting a front wheel (112) and a rear wheel (114) and a seat (136);

a front axle supporting the front wheel (112);

a rear axle supporting the rear wheel (114);

a pedal crank (116) for supplying muscle power;

said vehicle having a fuel tank (134), a fuel cell (150) for generating electricity, a battery (142), and an electric motor (156) for powering a drive wheel (114) and controls for the fuel cell (150) and electric motor (156); and

said drive wheel (114) having a planetary-gear train (132) having sun wheel (3) driven by an electric motor (156), a crown gear (6) driven by said muscle power, and a planetary-gear carrier (5) of the drive wheel (114) of the hybrid vehicle, said planetary-gear carrier (5) providing a power take-off to the drive wheel (114).

7. The two wheel vehicle of claim 6, in which there is a control to regulate the fuel cell (150) and a control to regulate the speed of the electric motor (156).

8. A two wheel vehicle (110) powered at least in part by a fuel cell (150) comprising:

a vehicle frame supporting a front wheel (112) and a rear wheel (114) and a seat (136), said frame forming an opening between the wheels (112, 114) for the placement and attachment to the frame of a power module (126);

a front axle supporting a front wheel (112);

a rear axle supporting a rear wheel (114);

a pedal crank (116) powered by muscle power;

a power module (126), said module including a fuel cell (150), battery (142), and control means for controlling the power to the rear wheel (114) of the vehicle (110);

a fuel tank (134);

means for detachable attaching the power module (126) to the frame;

an electric motor (156) for powering a drive wheel (114) of the vehicle;

said drive wheel (114) having a planetary-gear train (132) having sun wheel (3) driven by an electric motor (156), a crown gear (6) driven by said muscle power, and a planetary-gear carrier (5) of the drive wheel (114) of the hybrid drive vehicle, said planetary-gear carrier (5) providing a power take-off to the drive wheel (114).

9. The two wheel vehicle of claim 8, in which there is a control to regulate the fuel cell (150) and a control to regulate the speed of the electric motor (156).

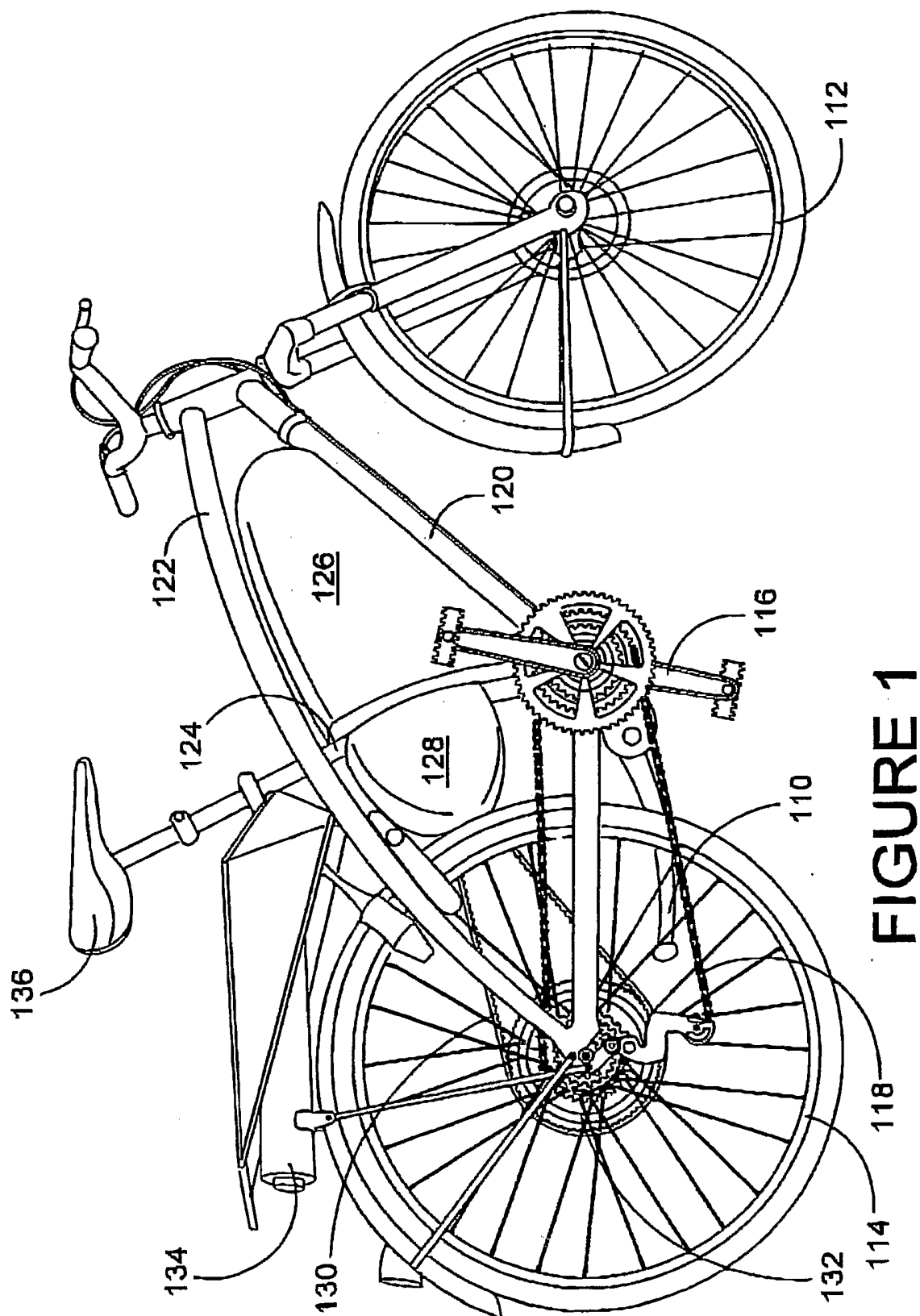
10. The two wheel vehicle of claim 8, in which said opening between the wheels (112, 114) is triangular in shape defined by a top front fork (122), a bottom front fork (120) and a back connecting base (124).

11. The two wheel vehicle of claim 8, in which the electric motor (156) drives a sun wheel (3) by a motor drive belt (130) and the crown gear (6) is driven by the pedal drive chain (118) attached to a gear on the pedal crank (116) which is driven by muscle power.

12. The fuel cell powered vehicle (110) of claim 8, in which the hydrogen can be stored in the fuel tank (146) as a hydrogen carbide.

13. The fuel cell powered vehicle of claim 12, in which the carbide is an iron carbide.

14. The fuel cell powered vehicle of claim 8, which has sensors to determine the speed of and load placed on the pedals (116) and transmit this information to a microprocessor in the vehicle which has been programmed to control the speed of the electric motor (156) according to the load on the pedals (116) and their speed so as to provide the desired assistance in pedaling the vehicle (110).



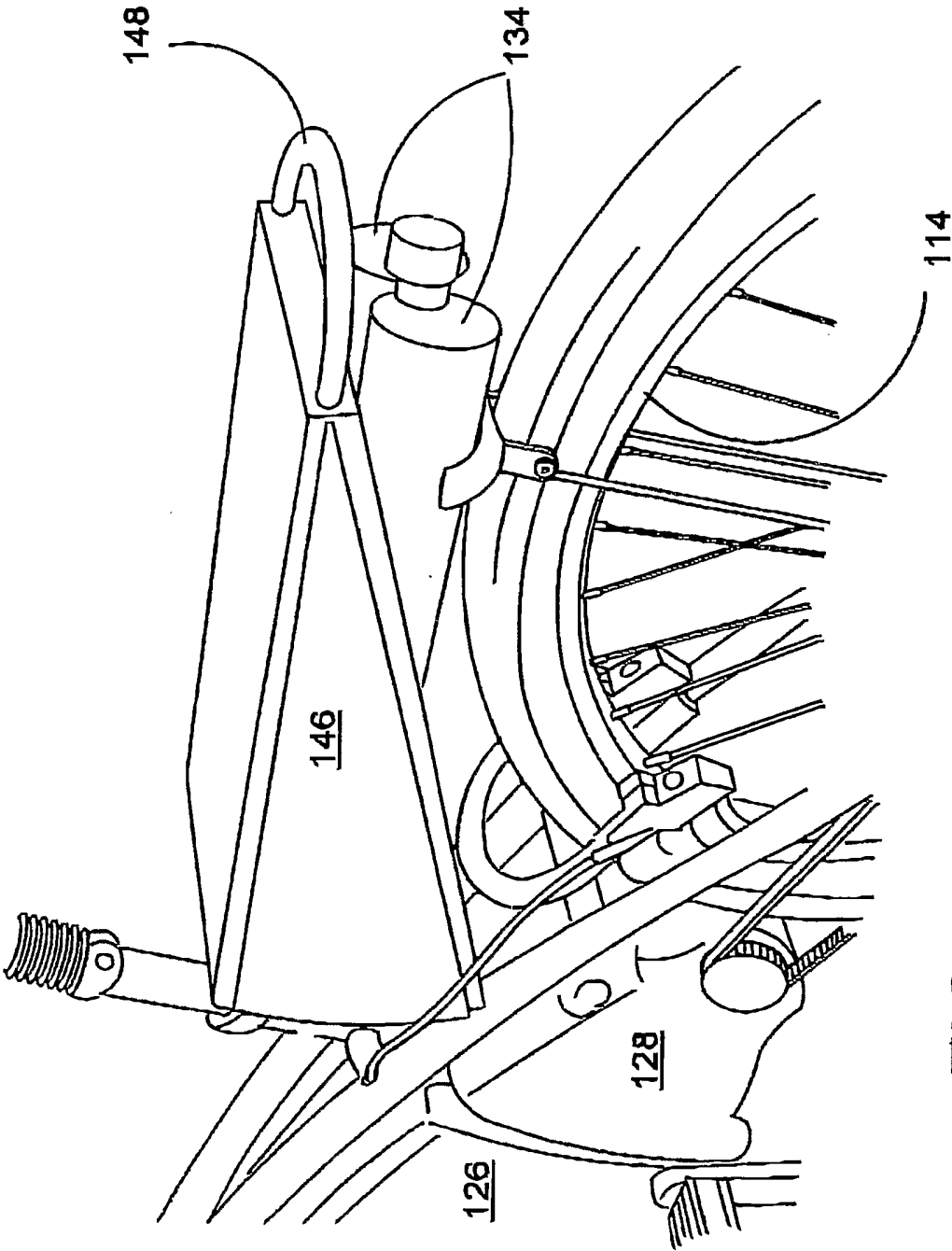


FIGURE 2

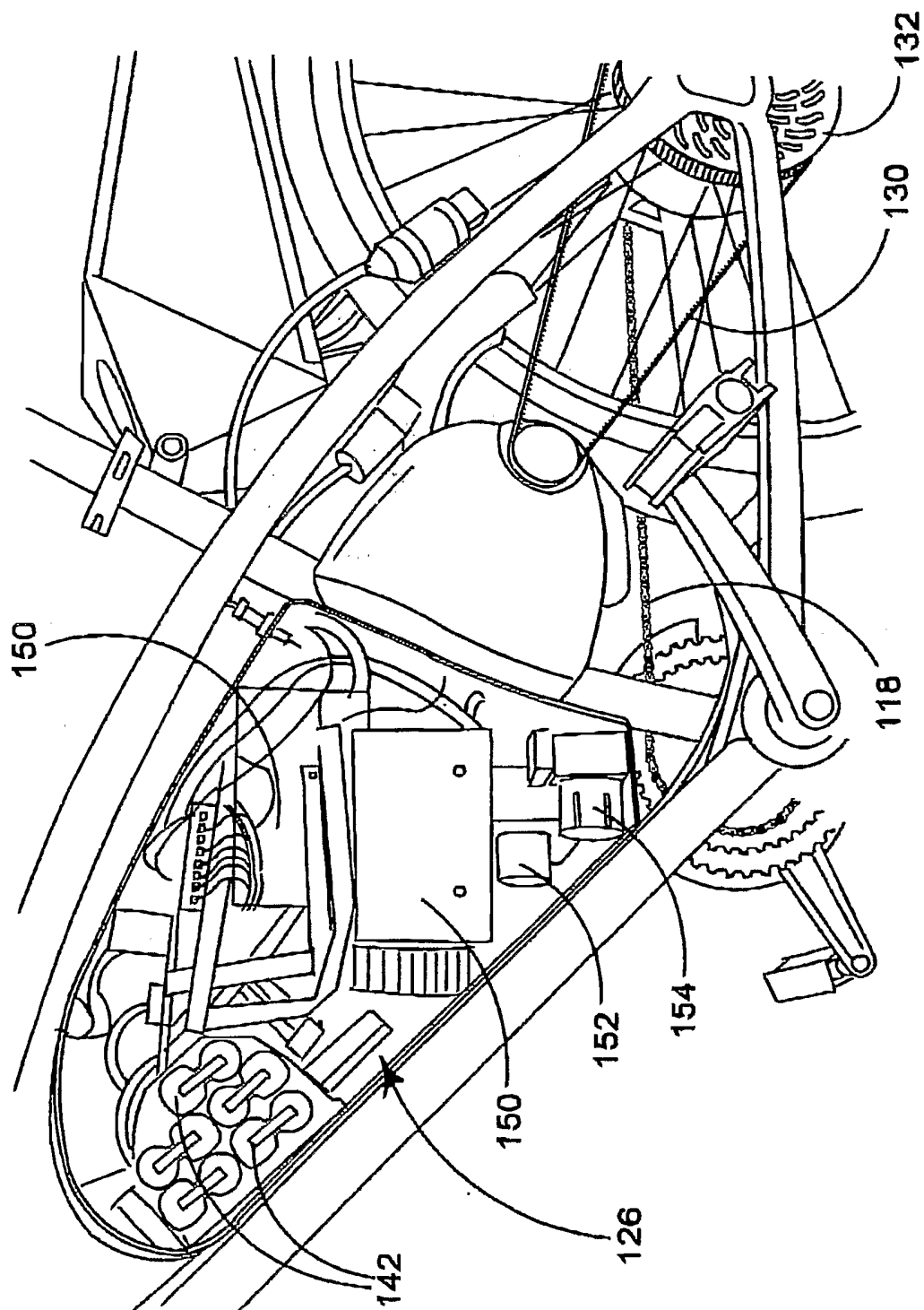


FIGURE 3

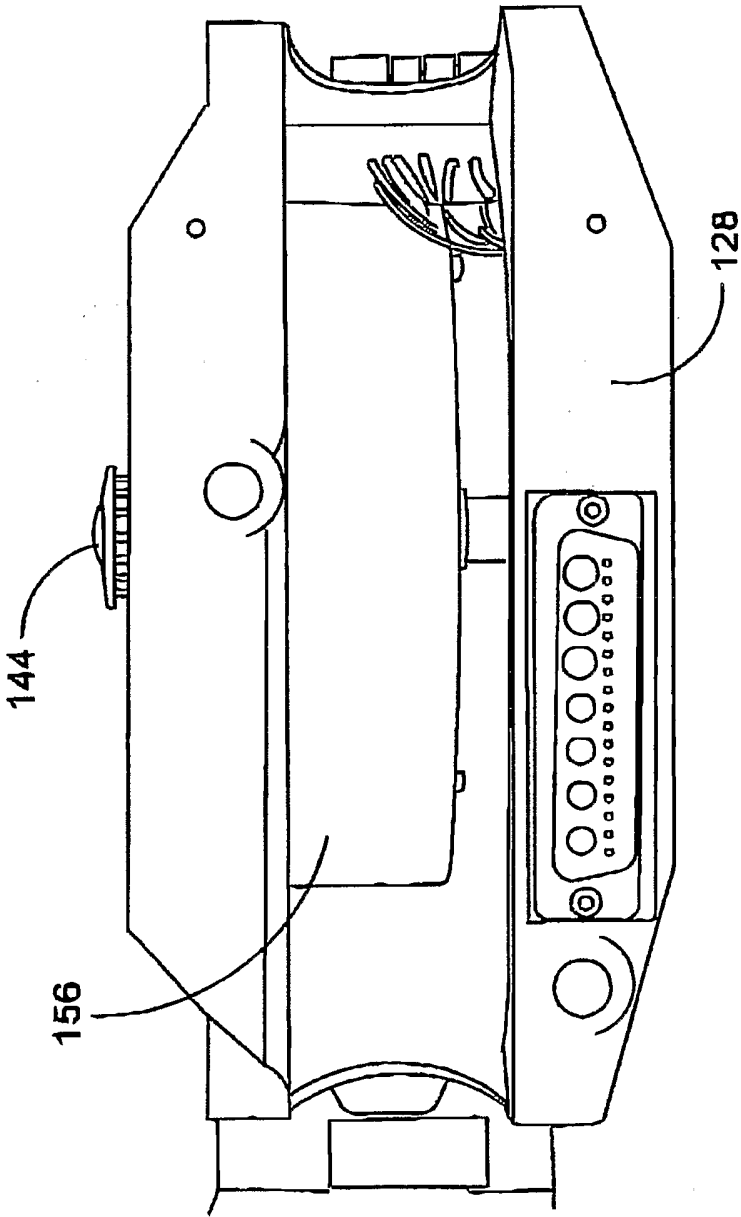


FIGURE 4

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP2005/009009

A. CLASSIFICATION OF SUBJECT MATTER
B62M23/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B62M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 01, 14 January 2003 (2003-01-14) & JP 2002 249090 A (YAMAHA MOTOR CO LTD), 3 September 2002 (2002-09-03)	1-8, 21, 24-27
Y	abstract; figures	9-20, 22, 23
Y	----- US 6 286 616 B1 (KUTTER MICHAEL) 11 September 2001 (2001-09-11) cited in the application the whole document	9-13, 19, 20
Y	----- US 5 242 335 A (KUTTER ET AL) 7 September 1993 (1993-09-07) cited in the application the whole document	14-18, 22, 23
	----- -/--	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *G* document member of the same patent family

Date of the actual completion of the international search

11 November 2005

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22/11/2005

Name and mailing address of the ISA

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/009009

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 1996, no. 09, 30 September 1996 (1996-09-30) & JP 08 119180 A (MATSUSHITA ELECTRIC IND CO LTD), 14 May 1996 (1996-05-14) abstract; figures 1-5 -----	1-8, 24-26
X	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 21, 3 August 2001 (2001-08-03) & JP 2001 095109 A (TOSHIBA CORP), 6 April 2001 (2001-04-06) abstract; figures -----	1-4, 8
X	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 04, 2 April 2003 (2003-04-02) & JP 2002 362470 A (YAMAHA MOTOR CO LTD), 18 December 2002 (2002-12-18) abstract; figures -----	1-5, 8, 24
X	EP 1 398 263 A (ASIA PACIFIC FUEL CELL TECHNOLOGIES, LTD) 17 March 2004 (2004-03-17) the whole document -----	1
X	EP 1 164 049 A (HONDA GIKEN KOGYO KABUSHIKI KAISHA) 19 December 2001 (2001-12-19) the whole document -----	1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2005/009009

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-8,21-27

A two wheel motor vehicle powered at least in part by a fuel cell comprising:
a vehicle frame supporting at least one front wheel and one back wheel and a seat, said frame forming an opening between the wheels for the placement and attachment to the frame of a power module;
a front axle supporting any front wheel;
a rear axle supporting any rear wheel;
a power module, said module including a fuel cell, battery, and control means for controlling the power to a wheel of the vehicle;
a fuel tank;
means for detachably attaching the power module to the frame;
and an electric motor for powering a wheel of the vehicle.

2. claims: 9-13,19,20

A two wheel motor vehicle with hybrid propulsion system for driving a drive wheel comprising:
a vehicle frame supporting a front wheel and a back wheel and a seat;
a front axle supporting the front wheel;
a rear axle supporting the rear wheel;
a pedal crank;
said vehicle having a fuel tank, a fuel cell for generating electricity, a battery, and an electric motor for powering a drive wheel and controls for the fuel cell and electric motor;
said electric motor having a rotor and a stator forming a first propulsion source with a first rotation per minute(rpm) and a first torque, and a second propulsion source with a second rpm and a second torque, with the stator of the electric motor rotatably arranged on one of an axle and a shaft of a drive train between the pedal crank and the drive wheel which can be mechanically connected with the second propulsion source so that the stator is driven by the second propulsion source, and the rotor of the electric motor having a rotational speed that corresponds to a sum of the first rpm of the first propulsion system and the second rpm of the second propulsion system.

3. claims: 14-17

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

A two wheel motor vehicle with a hybrid propulsion system for driving a drive wheel comprising:
a vehicle frame supporting a front wheel and a back wheel and a seat;
a front axle supporting the front wheel;
a rear axle supporting the rear wheel;
a pedal crank for supplying muscle power;
said vehicle having a fuel tank, a fuel cell for generating electricity, a battery, and an electric motor for powering a drive wheel and controls for the fuel cell and electric motor; and
said drive wheel having a planetary-gear train having sun wheel driven by an electric motor, a crown gear driven by said muscle power, and a planetary-gear carrier of the driven wheel of the hybrid drive vehicle, said planetary-gear carrier providing a power take-off to the drive wheel.

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