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An electric bike with variable modes

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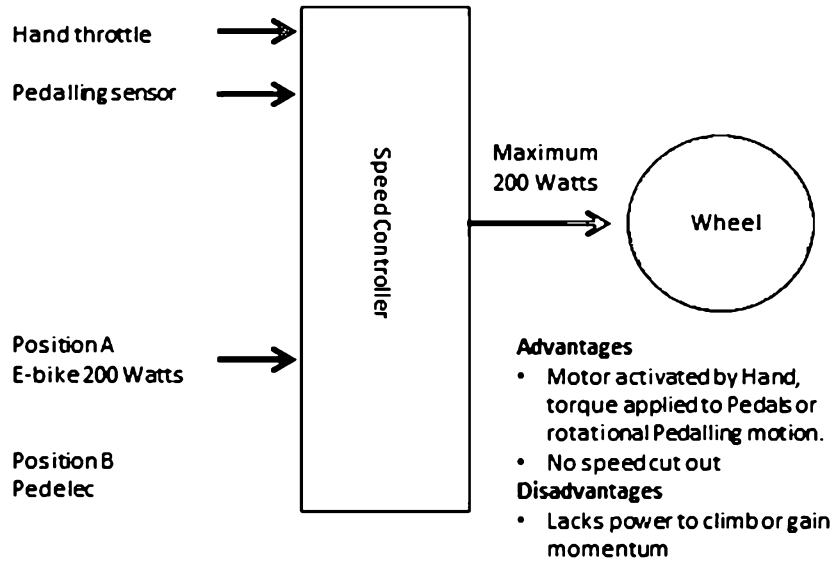
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ABSTRACT

The invention is an electric bike which comprises a bicycle, an electric motor, a pedalling sensor, and a controller in which the electric bike may be operated in one of two modes, being pedelecs mode or e-bike mode, allowing the bike to conform to all Australian standards and allowing the electric motor to provide a maximum output of 250watts when the electric bike is travelling less than 25kph and a maximum output of 200watts when the electric bike is travelling over 25kph.

Figure 1

E-bike Mode



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- There is 7 pages of Description only

An electric bike with variable modes

Background

[001] In Australia an electric bicycle can operate in one of two modes and still be considered a bicycle and not require a licence to ride. The first mode is referred to as Pedelec or EPAC in which the motor only assists when the rider is pedalling. The second mode is referred to as an E-bike and it has a motor that can operate at any time but is limited to an output of 200 watts of power.

[002] Until now a singular bicycle would be one or the other, but the current invention is directed to an a bicycle with an electric motor with a controller which allows for a singular bicycle to operate in either mode depending on selections by the rider and the speed at which the bicycle is travelling.

[003] An e-bike is not required to have a speed sensor. A pedelec must have a speed sensor. A pedelec must not apply power above 25kph, (10% tolerance allowed) and the rider must be pedalling.

[004] A pedelec can apply power by by rider request through a twist, throttle, button, or other means without pedalling, in this mode power is available from standing start until 6kph is reached.

Description of the Invention

[005] In this specification the term bicycle means: (a) a vehicle with 2 or more wheels that is built to be propelled by human power through a belt, chain or gears, whether or not it has 1 or more auxiliary motors; and (b) includes the following— (i) a pedicab; (ii) a penny-farthing;

(iii) a tricycle; (iv) a power-assisted bicycle; but (c) does not include the following— (i) a wheelchair; (ii) a wheeled recreational device; (iii) a wheeled toy; (iv) any vehicle with 1 or more auxiliary motors, other than a power-assisted bicycle.

[006] At 1 March 2017, in Australia both types are legal to ride under the same laws that apply to a regular bicycle provided type 1 meets the requirements of the European Standard EN15194:2009 or EN15194:2009+A1:2011 for Pedelecs and for E-bikes that they provide no more than 200 Watts of assistance as measured at the driven wheel.

[007] The bicycle of the present invention comprises:

- a. A bicycle
- b. An electric motor
- c. A controller; and
- d. At least one selection apparatus or a sensor which interact with the controller to change how the electric motor operates.

[008] The bicycle and the electric motors that may be used in this invention are standard bicycles and motors that have been used in electric bicycles for a long time. The invention lies in the addition of the controller. The controller may act in two ways : the rider has the ability to select the mode in which the rider wishes the bike to operate; or the controller, or an associated sensor, senses the conditions at which the bicycle is operating and selects the most appropriate mode of operation.

[009] There are advantages in different situations to both the pedelecs and e-bike modes of operation. For example, when operating in the pedelecs mode, the rider is provided with extra power to assist in the ascent of hills, or to accelerate more rapidly than through the exertions of the rider alone.

[010] When operating as an e-bike, there is an advantage in that the speed at which the bicycle is travelling can be increased, but there is not enough power to assist in the ascent of a hill.

[011] The invention is an electric bike which comprises a bicycle, an electric motor, a pedalling sensor, and a controller in which the electric bike may be operated in one of two modes, being pedelecs mode or e-bike mode, allowing the bike to conform to all Australian standards and allowing the electric motor to provide a maximum output of 250watts when the electric bike is travelling less than 25kph and a maximum output of 200watts when the electric bike is travelling over 25kph.

[012] The present invention also includes a method of riding an electric bicycle, the electric bicycle characterised by the inclusion of a controller and a selection apparatus, comprising the riding operating the bicycle as usual, and manually activating a switch to select either pedelec mode or Ebike mode.

[013] This instructs the motor controller to limit the power being outputted to the motor.

a. $V \text{ Battery (Voltage)} \times I = \text{Current (Amps)} = P \text{ Power (Watts)} / \text{Motor efficiency}^* \text{ factor}$

[014] Typically the cycle will have a Battery voltage of 36 Volts X 7 Amps Maximum = 252 Watts X 75% efficiency = 189 Watts at the wheel.

[015] Electric bicycles are generally equipped with a DC Motor, some of the inputted power is lost as heat. The motor will typically turn only 75% of the supplied energy into rotational force.

[016] In another aspect of the invention, there is an electric bicycle comprising:

- a. A bicycle;
- b. An electric motor;
- c. A sensor apparatus; and
- d. A controller,

in which the controller has two modes of operating, pedelec mode, being when the electric motor only runs when a rider of the bicycle is pedalling, or e-bike mode, being when the electric motor can run at any time, from stand still or when the bicycle is in motion with a maximum power output of 200 watts, and the sensor is able to sense how the rider wishes to apply additional power from the motor. bicycle is being operated including whether or not a rider is pedalling and the sensor then affects the controller to control the electric motor in the to assist the rider in the optimal manner for the conditions in which the bicycle is operating.

[017] In another aspect of the invention there is a method of operating an electric bike comprising a bicycle, an electric motor, a pedalling sensor, and a controller in which the pedalling sensor senses the conditions at which the bike is being operated and selects the appropriate mode from pedelecs mode or e-bike mode.

[018] The controller determines the best operating mode based on information supplied by the rider through the display/mode switch and sensors. The rider can select a mode which instructs the controller to minimise power usage to extend the possible range - Level 1. Or they can select a setting for higher power to climb hills and maximum assistance to gain great road speed – Level 5.

[019] In Level 1 the controller for example will limit the current to 2 Amps. In this mode the bike will not exceed 200 Watts and therefore the controller will operate in E-bike mode and will allow the rider to activate the power assist by either pedalling or hand throttle and will not cut the power out at 25 km/h.

[020] In Level 5 the controller will allow maximum current when pedalling up to 25 km/h providing the rider is pedalling, the throttle if activated while pedalling will have no effect, (Pedelec) If the throttle is activated and the rider is not pedalling the power outputted by the motor will not exceed 200 Watts, (E-bike). Once the bike reaches 25 km/h the power will be reduced to 200 Watts, (E-bike).

MODE	POWER	INPUTS		
		Hand Throttle	Pedal sensor	Button
E-bike	Max 200 Watts	YES	YES	YES
Pedelec	201+ Watts*	YES (Max 6km/h)	YES (Max 25 km/h)	YES (Max 6 km/h)

- Conforming parameters for Pedelec's as per EN15194.

[021] When operating in e-bike mode the controller will limit the power output at the wheels by limiting by controlling the relationship between Voltage and Current, using the equation:
 $V \text{ Battery (Voltage)} \times I = \text{Current (Amps)} = P \text{ Power (Watts)} / \text{Motor efficiency* factor}$

[022] In a further aspect of the invention there is a controller for an electric motor on an electric bicycle which has two modes of operation being pedelec mode in which the electric motor will only operate when a rider of the electric bicycle is pedalling, and e-bike mode, in which the electric motor will operate with a maximum power of 200 watts.

[023] In another aspect of the invention there is a pedalling sensor for use with an electric bike comprising a bicycle, an electric motor and a controller in which the pedalling sensor senses the operating conditions of the electric bicycle and choose the optimal mode in which the electric motor should operate to provide optimal assistance to a rider of the electric bicycle.

[024] Methods of Rider requesting power include:

1. Pedalling
 - 1.1 Rotational sensor – a sensor is fitted to the bike to detect forward rotation of the crank when pedalling.
 - 1.2 Torque sensor - Pressure applied to the pedal is measured as torque and activates the controller.
2. Hand throttle
 - 2.1 Twist type – variable hand or thumb actuated sensor, twisting signals to controller the riders request for power.
3. Start up assistance
 - 3.1 Button – Commonly referred to as ‘Walk mode’. Power assistance provided up to 6 km/h designed speed or lower values. Mode activated by the voluntary and maintained action of the user either when riding without pedalling or when the user is pushing the cycle.

Description of the Drawings

Figure 1 depicts how the electric bicycle would operate when e-bike mode is selected by the rider.

Figure 2 depicts how the electric bicycle would operate when pedelec mode is selected by the rider

Figure 3 depicts how the bicycle would operate when the controller does the selecting.

Examples of the invention

[017] Rider applies throttle only, no pedal input. Controller acts as an Ebike

[018] Rider is increasing pedalling input to increase road speed from 7kph to 24kph. Controller acts as Pedelec.

[019] Rider increases speed from 24kph to 29kph. At 25kph the controller switches from acting as an Pedelec to a Ebike.

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[020] Rider decreases speed from 29 kph to 23 kph . At 25kph the controller switches from acting as a Ebike to a Pedelec.

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EDITORIAL NOTE

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- There is 2 pages of Claims only

Claims

1. An electric bicycle comprising:

- a. A bicycle;
- b. An electric motor;
- c. A selector apparatus; and
- d. A controller,

in which the selector apparatus has two modes which may be selected, pedelec mode, being when the electric motor only runs when a rider of the bicycle is pedalling, or e-bike mode, being when the electric motor can run at any time that the bicycle is in motion with a maximum power output of 200watts, and the selector apparatus causes the controller to control the manner in which the electric motor operates.

2. An electric bicycle comprising:

- a. A bicycle;
- b. An electric motor;
- c. A sensor apparatus; and
- d. A controller,

in which the controller has two modes of operating, pedelec mode, being when the electric motor only runs when a rider of the bicycle is pedalling, or e-bike mode, being when the electric motor can run at any time that the bicycle is in motion with a maximum power output of 200 watts, and the sensor is able to sense how the bicycle is being operating including whether or not a rider is pedalling, and the sensor then affects the controller to control the electric motor in the to assist the rider in the optimal manner for the conditions in which the bicycle is operating.

3. A controller for an electric motor on an electric bicycle which has two modes of operation being pedelec mode in which the electric motor will only operate when a rider of the electric bicycle is pedalling, and e-bike mode, in which the electric motor will operate with a maximum power of 200 watts.

4. An electric bicycle comprising:

- a. A bicycle;
- b. An electric motor;
- c. A selector apparatus;
- d. A controller, and
- e. A pedalling sensor

in which the selector apparatus has two modes which may be selected, pedelec mode, being when the electric motor only runs when a rider of the bicycle is pedalling with a maximum power output of 250watts when the bike is travelling below 25kmp, or e-bike mode, being when the electric motor can run at any time that the bicycle is in motion with a maximum power output of 200watts when the bike is travelling above 25kmp, and the selector apparatus causes the controller to control the manner in which the electric motor operates.

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EDITORIAL NOTE

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- There are 3 pages of Drawings only

Figure 1

E-bike Mode

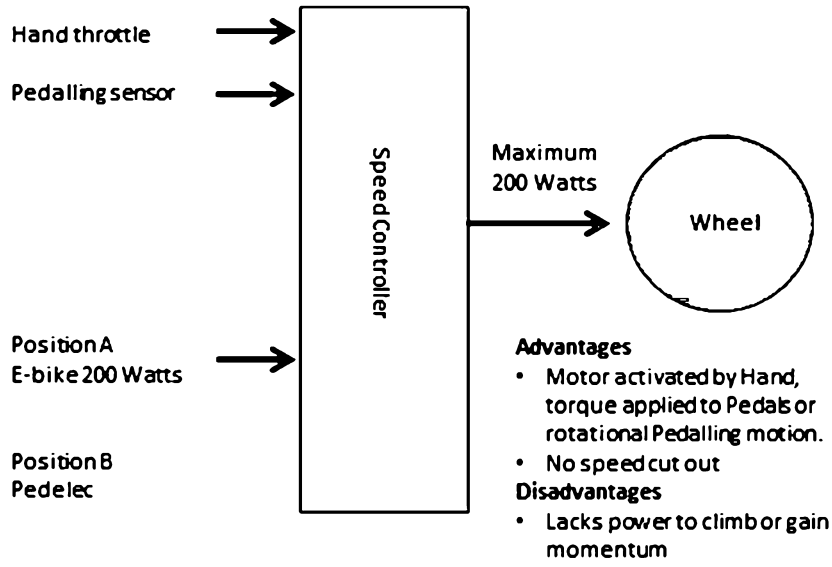


Figure 2

Pedelec Mode

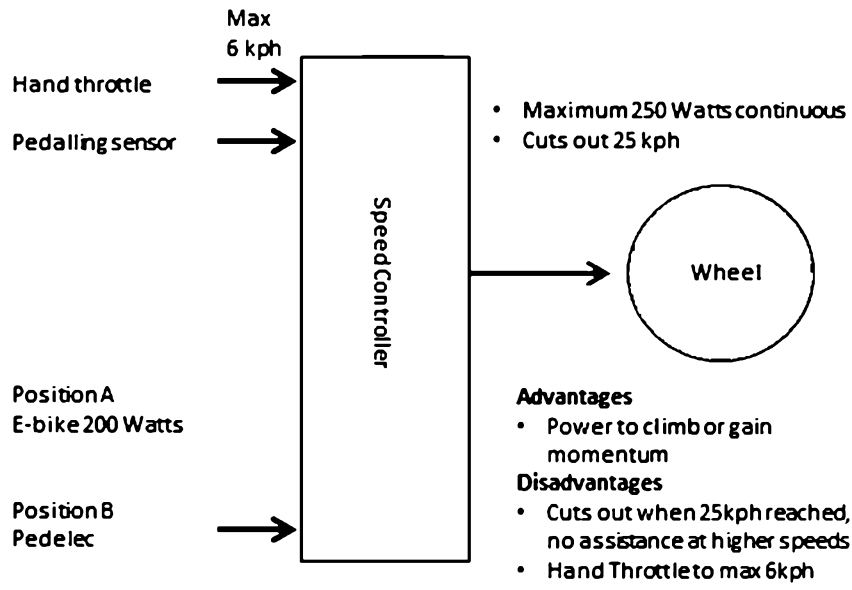


Figure 3

Electronic selection

