[19]中华人民共和国专利局

[51]Int.Cl[6]
B62M 23/02

[12] 实用新型专利说明书

[21] ZL 专利号 96237586.1

[45]授权公告日 1997 年 11 月 19 日

[11] 授权公告号 CN 2268001Y

[22]申请日 96.10.11 [24]颁证日 97.10.18
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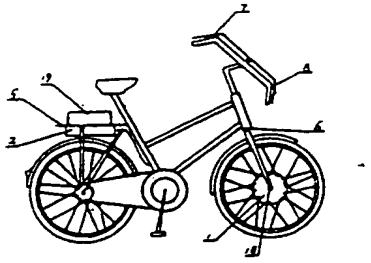
[54]实用新型名称 电动助力车

[57]摘要

一种电动助力车，由普通自行车、电机、电子转换器、蓄电池等组成，本实用新型设计新颖，普通自行车后轮轴或前轮轴用具有稀土金属固定永磁磁铁的三相同步无电刷，无传感器双向传动电机轴代替，由蓄电池提供能量，装有电子转换器，转换、传动效率高，行驶安全，不改变原有传动系统及原脚踏功能，是目前较理想的交通工具之一。



(BJ)第 1452 号

权 利 要 求 书

1．一种电动动力车，由普通自行车．电机．电子转换器．蓄电池等组成，其特征在于：用具有稀土金属固定永磁磁铁的三相同步无电刷．无传感器双向传动电机轴(9)代替普通自行车后轮轴或前轮轴(18)．与右端盖(12)上的飞轮(4)相联，蓄电池(3)装在自行车三角架下方及斜梁(6)或装在后尾架(19)上，电子转换器(2)装在后座架(5)下面，左．右手闸(7)．(8)装有微动开关；

2．据权利要求1所述的电动动力车，其特征在于：电机(1)的铁芯(16)．线圈(17)通过电机轴(9)与自行车架相配合，固定于自行车后三角架或前叉上，电机线圈采用双层绕组，星形接线，由四线组成．A．B．C三根接到驱动器上，N一根中线接至信号检测电路，电源线通过固定轴引出，电机轴(9)的尺寸可直接与各种型号的24寸．26寸．28寸自行车相配，磁环(13)与左右端盖(11)．(12)外缘有钢线孔(15)，通过钢线直接与后轮或前轮钢圈装配，螺栓孔(14)用来固定左右端盖；

3．据权利要求1所述电动动力车，其特征在于：电子转换器(2)电路由电源．滤波器．辅助电源．电机转子位置信号检测．预放电路．制动．过流保护电路．比较放大器．反相器．触发器．中央处理器等组成，主电源由电池24V经滤波器提供电机电源，另一路输送主开关电源，滤波器使电池进出电流保持低波动，辅助电源由开关电源IC，开关管．开关变压器组成，输出四组不同的数值电压提供所有IC工作电压，减少电池电压变化大和几种备用电压所产生的损失，电机转子位置信号检测由IC3和电阻网络等元件组成，从电机线圈中提取脉冲信号送至IC3进行放大取样，输出到CPUIC$_2$位置信号处理器中进行数据处理，输出到CPUIC$_1$；预放电路由IC$_1$提供脉冲形状信号，进行放大后控制场效应管，24V通过8只场效应管，依次导通，为A．B．C线圈轮流供电，使电机转动；制动．过流保护电路：当开关K$_1$合上时，在IC$_4$3脚和12脚，运放①．⑭＋端产生一个低电平，IC$_4$1脚．14脚输出一信号电压送到IC$_1$10脚．14脚进行处理，关断18脚-25脚脉冲信号，从而关断电机电源，避免器件因电机停转而造成的损坏，电机电

流过大，在RO_1两端产生一电压降送到IC_4运放②进行比较，在IC_4.7脚输出一信号电压送至IC_6比较放大，这一信号反馈IC_4运放①，使运放①输出端输出一信号送至$IC_1$10脚进行数据处理后，调节驱动器输出电流，以稳定电机电流；比较放大器制动及保护电路的放大信号，对主、辅电源执行监控，放大后的信号送给施密特触发反相器中进行信号整形，电平转换，控制触发器，送至CPU进行处理；中央处理器由2片可编程单片机IC_1、IC_2对整个电路执行系统控制，IC_1输出一组时序脉冲信号，控制预放电路的工作状态，IC_1控制主电源，当K_1闭合时，IC_1接收一个触发脉冲同IC_2进行数据交换；IC_2是当电机转动后，由位置信号检测IC_8送来的信号进行逻辑处理，使IC_1输出一组脉冲信号，使电机线圈供电轮流导通，同IC_1进行数据交换，包括继电器启停、制动、过流、欠压和超压的控制，电子转换器(2)和电机(1)，蓄电池(3)联接；IC_6是一个在输入级具有施密特触发功能的反相器，其主要作用是将电池电压24，开关电源输出5V电压经降压后的TTL高电平分别送到IC_{6-11}脚和9脚进行电平倒相，由10脚、8脚输出一低电平，同时由IC_{2-10}脚输出的高电平经反相后的低电平由6脚输出，另一路则由IC_6-1.2.13.14脚送来的各种控制信号进行整形、倒相，输出一低电平的以适应IC_7接口电路的要求，其功能主要是进行电平转换、信号整形；IC_7是一个双D触发器，主要作用是为IC_8-IC_{11}提供一个时钟控制信号，控制IC_8-IC_{11}的开启与关闭，另一路将各种保护控制信号，制动控制信号，送至IC_1即CPU进行数据逻辑处理，IC_7-1脚输出一个TTL高电平送到IC_1-15脚，IC_1即开始工作，同样由IC_7-5脚输出一个TTL高电平送到IC_2-2脚让IC_2开始工作，IC_7-3脚为时钟输入端，由IC_2-9脚提供时钟信号；IC_5为主要电源升压电路，实际上属一种并联式开关电源，为了提高效率，使电机转速平衡，补充因瞬间电池电压跌落提供电能，当电池电压波动时也同样起到稳定电源电压之目的；IC_9为场效应管驱动电路，它有两个驱动信号输出端，正常工作时只有一个驱动信号输出，两个输出端轮流交替工作，使电机线圈A、B、C端轮流换相供电，以便产生旋转磁场，它有一个时钟控制端为11脚，由IC_7控制，它能使两个输出端全部停止输出，即C相电机供

电点的两个场效应管也停止工作，切断电机电源供电点；IC_{10}、IC_{11}、同IC_9工作原理相同，这里不再繁述，IC_9为C相电源驱动，IC_{10}为B相电源驱动，IC_{11}为A相电源驱动，三个集成电路由IC_1-18脚至25 脚输出的低频脉冲时序信号工作.

说　　明　　书

电动助力车

本实用新型属一种电动助力车。

目前，电动助力车有各种各样，例如专利88218203.X电动自行车、专利93232844.X电动自行车，专利93242727.8电动助力车等结构较复杂，是由蓄电池直接启动电动机，而所使用的电动机一般都是带电刷的，磨损大，故障率高，要经常维修，或要另设传动机构来达到电动的目的，传动效率较低，有些还要采用两个电机，令造价更高，不能广泛推广使用。

本实用新型的目的是提供一种电动助力车，采用具有稀土金属固定永磁磁铁的三相同步无电刷、无传感器双向传动电机轴代替自行车后轮轴或前轮轴，不需另加传动装置，传动、转换效率高，由蓄电池提供能量，不改变原有传动系统及原脚踏功能。

本实用新型由普通自行车、电机、电子转换器、蓄电池等组成，用具有稀土金属固定永磁磁铁的三相同步无电刷、无传感器双向传动电机轴(9)代替普通自行车后轮轴或前轮轴(18)，与右端盖(12)上的飞轮(4)相联，蓄电池(3)装在自行车三角架下方及斜梁(6)或装在后尾架(19)上，电子转换器(2)装在后座架(5)下面，左、右手闸(7)、(8)装有微动开关，电机(1)的铁芯(16)、线圈(17)通过电机轴(9)与自行车架相配合，固定于自行车后三角架或前叉上，电机线圈采用双层绕组，星形接线，由四线组成，A、B、C三根接到驱动器上，N一根中线接至信号检测电路，电源线通过固定轴引出，电机轴(9)的尺寸可直接与各种型号的24寸、26寸、28寸自行车相配，磁环(13)与左右端盖(11)、(12)外缘有钢线孔(15)，通过钢线直接与后轮或前轮钢圈装配，螺栓孔(14)用来固定左右端盖，电子转换器(2)电路由电源、滤波器、辅助电源、电机转子位置信号检测、预放电路、制动、过流保护电路、比较放大器、反相器、触发器、中央处理器等组成，

主电源由电池24V经滤波器提供电机电源，另一路输送主开关电源，滤波器使电池进出电流保持低波动，辅助电源由开关电源IC，开关管、开关变压器组成，输出四组不同的数值电压提供所有IC工作电压，减少电池电压变化大和几种备用电压所产生的损失，电机转子位置信号检测由IC3 和电阻网络等元件组成，从电机线圈中提取脉冲信号送至IC3 进行放大取样，输出到CPUIC$_3$位置信号处理器中进行数据处理，输出到CPUIC$_1$；预放电路由IC$_1$提供脉冲形状信号，进行放大后控制场效应管，24V通过8 只场效应管，依次导通，为A、B、C线圈轮流供电，使电机转动；制动、过流保护电路：当开关K$_1$合上时，在IC$_4$3脚和12脚，运放①、④＋端产生一个低电平，IC$_4$1脚、14脚输出一信号电压送到IC$_1$10脚、14脚进行处理，关断 18脚-25脚脉冲信号，从而关断电机电源，避免器件因电机停转而造成的损坏，电机电流过大，在RO$_1$两端产生一电压降送到IC$_4$运放②进行比较，在IC$_4$7脚输出一信号电压送至IC$_5$比较放大，这一信号反馈IC$_4$运放①，使运放①输出端输出一信号送至IC$_1$10脚进行数据处理后，调节驱动器输出电流，以稳定电机电流；比较放大器制动及保护电路的放大信号，对主、辅电源执行监控，放大后的信号送给施密特触发反相器中进行信号整形，电平转换，控制触发器，送至CPU进行处理；中央处理器由2片可编程单片机IC$_1$、IC$_2$对整个电路执行系统控制，IC$_1$输出一组时序脉冲信号，控制预放电路的工作状态，IC$_1$控制主电源，当K$_1$闭合时，IC$_1$接收一个触发脉冲同IC$_2$进行数据交换；IC$_2$是当电机转动后，由位置信号检测IC $_3$送来的信号进行逻辑处理，使IC$_1$输出一组脉冲信号，使电机线圈供电轮流导通，同IC$_1$进行数据交换，包括继电器启停、制动、过流、欠压和超压的控制，电子转换器(2)和电机(1)，蓄电池(3)联接；IC$_6$是一个在输入级具有施密特触发功能的反相器，其主要作用是将电池电压24，开关电源输出5V电压经降压后的TTL高电平分别送到IC$_{6-11}$脚和9脚进行电平倒相，由 10脚、8脚输出一低电平，同时由IC$_{2-10}$脚输出的高电平经反相后的低电平由6 脚输出，另一路则由IC$_6$-1. 2. 13. 14脚送来的各种控制信号进行整形、倒相，输出一低电平的以适应IC$_7$接口电路的要求，其功能主要是进行电平转换.

信号整形；IC_7是一个双D触发器，主要作用是为IC_8-IC_{11}提供一个时钟控制信号，控制IC_8-IC_{11}的开启与关闭，另一路将各种保护控制信号，制动控制信号，送至IC_1即CPU进行数据逻辑处理，IC_7-1脚输出一个TTL高电平送到IC_1-15脚，IC_1即开始工作，同样由IC_7-5脚输出一个TTL 高电平送到IC_2-2脚让IC_2开始工作，IC_7-3脚为时钟输入端，由IC_2-9脚提供时钟信号；IC_8为主要电源升压电路，实际上属一种并联式开关电源，为了提高效率，使电机转速平衡，补充因瞬间电池电压跌落提供电能，当电池电压波动时也同样起到稳定电源电压之目的；IC_9为场效应管驱动电路， 它有两个驱动信号输出端，正常工作时只有一个驱动信号输出，两个输出端轮流交替工作，使电机线圈A、B、C端轮流换相供电，以便产生旋转磁场， 它有一个时钟控制端为11脚，由IC_7控制，它能使两个输出端全部停止输出，即C相电机供电点的两个场效应管也停止工作，切断电机电源供电点；

IC_{10}、IC_{11}、同IC_9工作原理相同，这里不再繁述，IC_9为C 相电源驱动，IC_{10}为B相电源驱动，IC_{11}为A相电源驱动，三个集成电路由IC_1-18脚至25脚输出的低频脉冲时序信号工作。

本实用新型设计新颖，普通自行车后轮轴用具有稀土金属固定永磁磁铁的三相同步无电刷，无传感器双向传动电机轴代替，由蓄电池提供能量，装有电子转换器，转换、传动效率高，行驶安全，是目前较理想的效通工具之一。

附图说明：

图１(A)、图１(B)是本实用新型结构示意图；

图２是本实用新型电机外形图；

图３是本实用新型电机结构半剖图；

图４是本实用新型电子转换器方框图；

图５（Ⅰ）、（Ⅱ）是本实用新型电子转换器控制原理图。

本实用新型中除了电机、电子转换器要购元件装配外，其余皆可购到，然后按图１所示，蓄电池(3)装于特定制作的电池盒内， 固定在自行车三角架下方及斜梁(6)上或后尾架(19)上，电机(1)轴(9) 取代自行车原后轮

轴或前轮轴(18)，电机轴(9)固定于后轮轴位置或前轮轴位置(18)，装于电机(1)右端盖(12)飞轮轴上的飞轮(4)，取代自行车后轮飞轮位置，而保持原有人力传动装置不变，电机(1)转动部分，左右端盖(11)、(12)通过钢线与后轮钢圈连接而直接传动或前轮钢圈．电子转换器(2)安装在自行车后座架(5)之下面，电机(1)通过电子转换器(2)与电池(3)联接．电子转换器(2)上装有电源开关，需电动时，打开电源开关，用脚踏2-3圈后，电子转换器开始给电机(1)供电，电子转换器(2)具有检测及逻辑控制功能，在自行车停止运行时，即使打开电源开关，也不向电机供电，从而可避免电能静态损耗，在自行车的左右手闸(7)、(8)位置装有控制行驶速度的微动开关．一般状况下均属于接通状态，行驶中若需减速，无论启动前闸或后闸，均可切断电机电源，松开后自动恢复电机供电．本实用新型的联接固定部分均采用标准螺栓，安装极为方便．

说 明 书 附 图

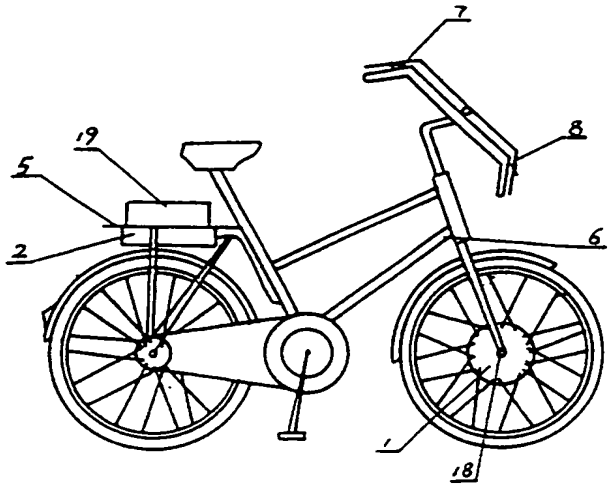


图 1 (A)

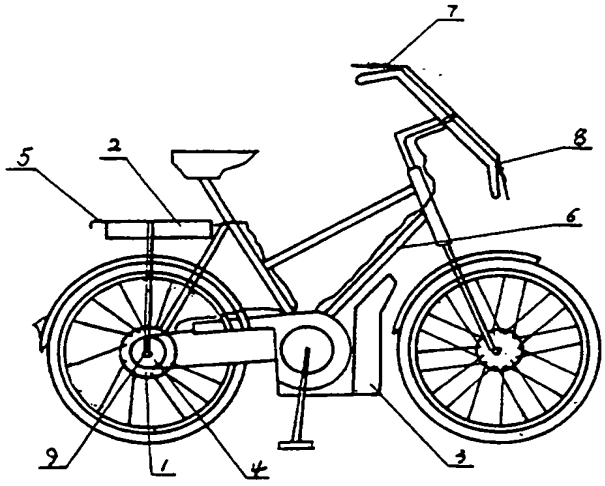


图 1 (B)

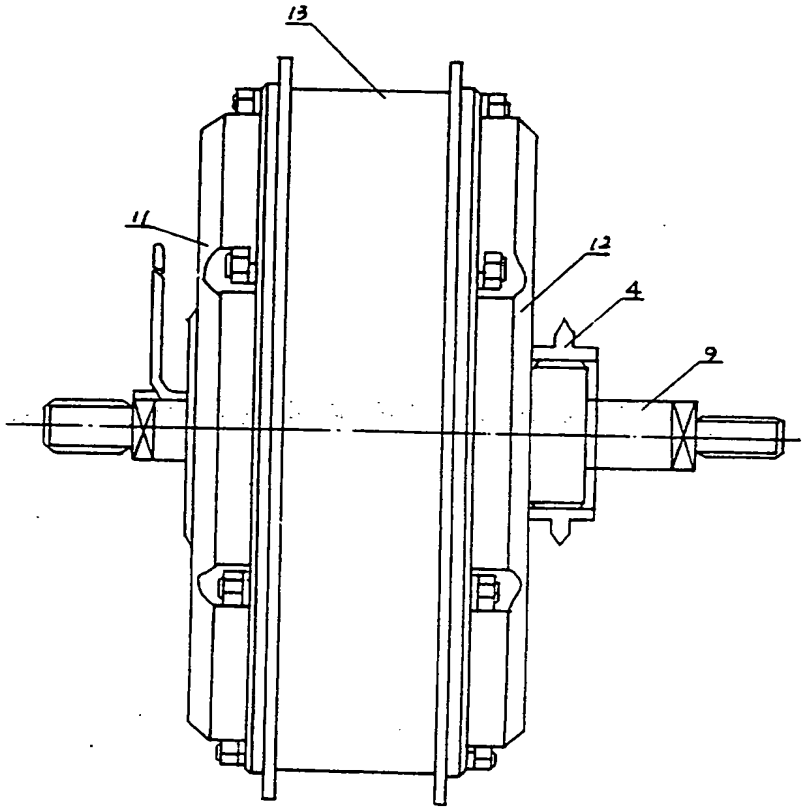


图 2

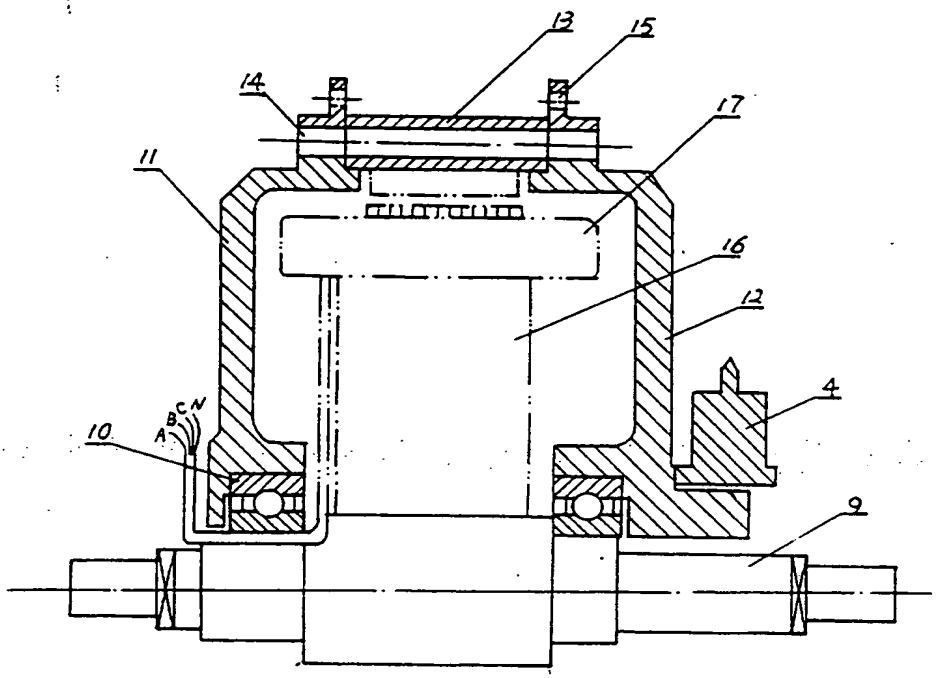


图 3

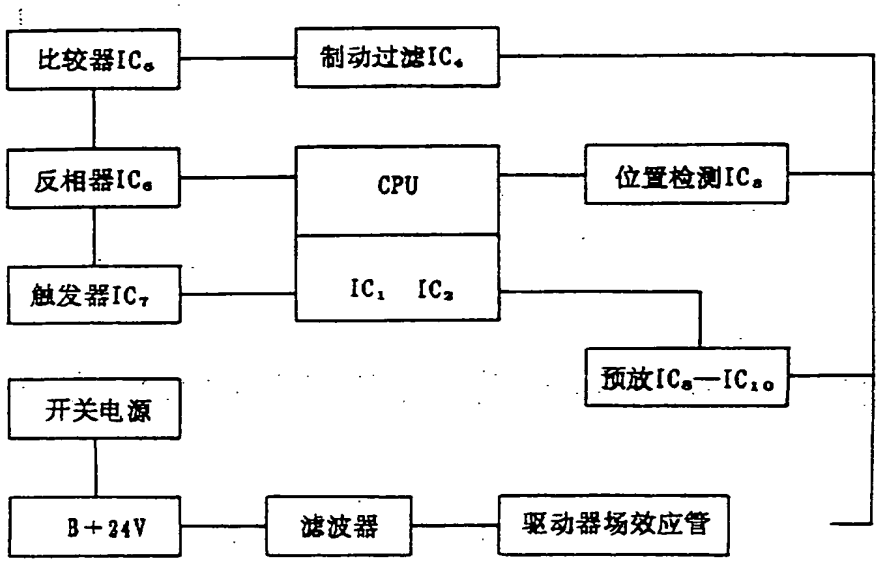

比较器IC₅
制动过滤IC₄
反相器IC₆
CPU
位置检测IC₃
触发器IC₇
IC₁ IC₂
预放IC₈—IC₁₀
开关电源
B+24V
滤波器
驱动器场效应管

图 4

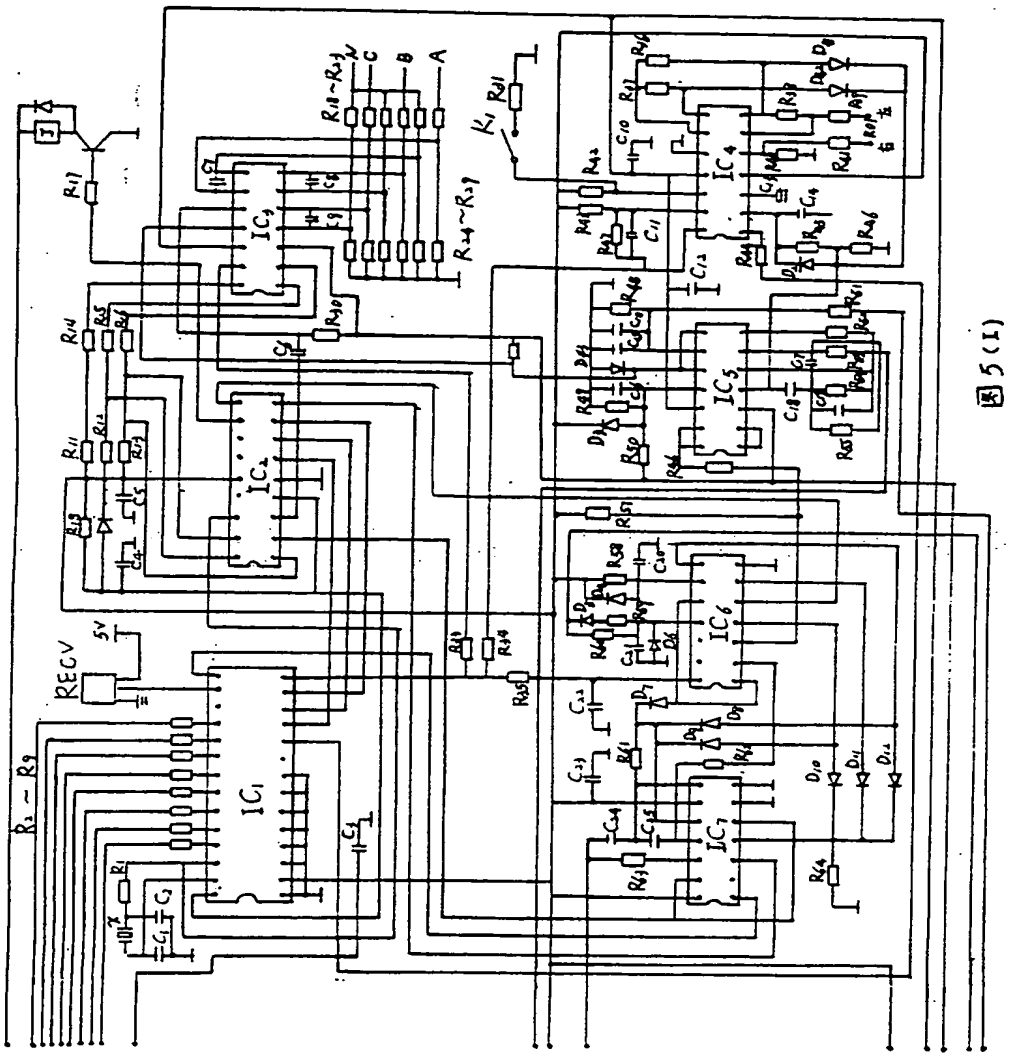


图 5 (1)

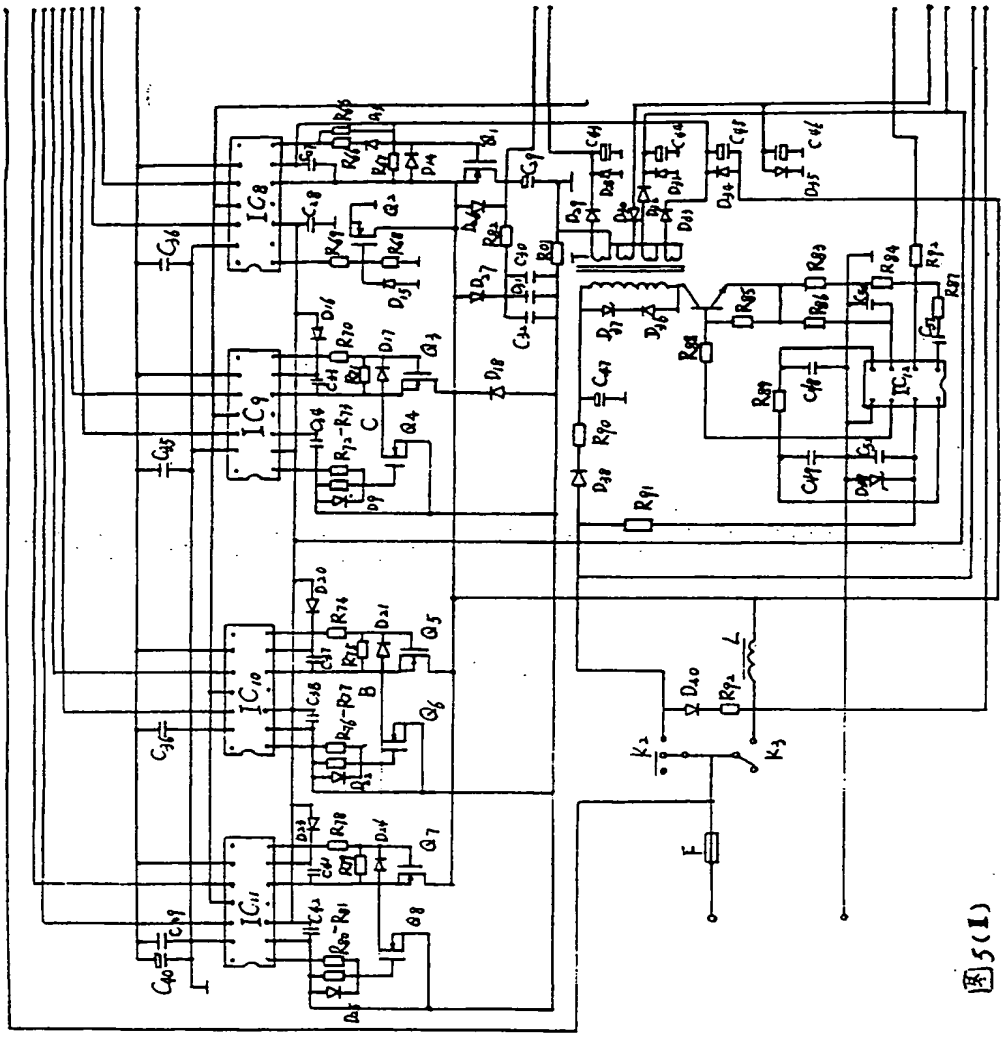


图5(1)

TRANSLATION OF CN22668001Y (D1)

[54] Title of the Utility Model:

ELECTRIC ASSISTANCE VEHICLE

[57] Abstract:

The electric assistance vehicle is composed of a typical bicycle, an electric motor, an electronic converter and a storage battery. The utility model has a novel design in that the rear axle shaft or the front axle shaft of the typical bicycle is replaced by the shaft of a three-phase synchronous brushless and sensorless bi-directional transmission electric motor having a fixed permanent magnet of rare-earth metal, the storage battery provides the energy therefor and the vehicle is equipped with the electronic converter. The converting and transmitting efficiency is relatively high, and it is safe to ride this vehicle, where the original transmission system and the original pedaling function are not changed. The vehicle is one of the ideal communications at present.

CLAIMS

1. An electric assistance vehicle composed of a typical bicycle, an electric motor, an electronic converter and a storage battery, characterized in that:

the rear axle shaft or the front axle shaft (18) of the typical bicycle is replaced by the shaft (9) of a three-phase synchronous brushless and sensorless bi-directional transmission electric motor having a fixed permanent magnet of rare-earth metal, which is connected with a fly wheel (4) configured on the right cover (12);

the storage battery (3) is configured below the tripod stand and the lower incline grinder (6) or configured on the rear tailstock (19);

the electronic converter (2) is configured below the rear ledge; and

the left and the right brakes (7, 8) are equipped with a respective micro switch.

2. The electric assistance vehicle as claimed in Claim 1, characterized in that:

the core (16) and the coil (17) of the electric motor (1) are corresponding to the bicycle frame through the shaft (9) of the electric motor and fixed on the rear tripod stand or the front fork of the bicycle where the coil of the electric motor adopting a double-layer winding and a star wiring composed of four lines, and three of which (A, B, C) are connected to a driver while the neutral one (N) is connected to a signal detecting circuit;

the power cord is drawn out via the fixing shaft;

the shaft (9) of the electric motor is directly correspondent to each type of bicycle including a 24-inch, a 26-inch and a 28-inch one having a steel wire hole (15) configured outside the magnetic ring (13) as well as the left and the right covers (11, 12), and equipped to the rear or the front steel diskwheel via the steel wire; and

the left and the right covers are fixed via a bolt hole (14).

3. The electric assistance vehicle as claimed in Claim 1, characterized in that:

the circuit for the electronic converter (2) is composed of a power supply, a filter, an auxiliary power supply, a signal detector for the position of the motor rotor, a pre-amplifying circuit, a braking and overcurrent-protecting circuit, a comparison amplifier, an inverter, a trigger and a central processing unit, wherein:

the primary power supply provides for the electric motor with a battery of 24V through the filter and the power for the primary switch is transmitted via the other end thereof;

the filter keeps the input and output currents of the battery at a low-fluctuation state;

the auxiliary power supply is composed of a switch power IC, a switch tube and a switch transformer, which outputs four different voltages as a respective operation voltage for all of the ICs and reduces the large variation in the voltage of the battery as well as the loss produced by the plurality of backup voltages;

the signal detector for the position of the motor rotor is composed of IC3 and a matrix of resistors, whereby a pulse signal is picked up from

the coil of the electric motor, transmitted to the IC3 for being amplified and sampled, output to the position signal processing unit $CPUIC_2$ for being digitally processed, and then output to the $CPUIC_1$;

the pre-amplifying circuit is provided with a pulse shape signal from the IC_1, whereby the pulse shape signal is amplified for further controlling the field effect transistor where eight field effect transistors are fed with 24V and conducting in turns for providing electricity to the coils A, B and C by turns, so as to enable the electric motor;

the braking and overcurrent-protecting circuit: when the switch K1 is off, a low voltage level is produced on the operational □ and □+ terminals at pin 3 and pin 14 of IC_4, a signal voltage is transmitted from pin 1 and pin 14 of IC_4 to pin 10 and pin 14 of IC_1 for being processed, the pulse signals on pin 18 to pin 25 are cut off and thus the power supply of the electric motor is switched off, so as to prevent the damage and the overcurrent of the electric motor caused by the failure thereof, a potential drop crossing the two terminals of RO_1 is produced and transmitted to the operational □ of IC_4 for being compared, a signal voltage output from pin 7 of IC_4 is transmitted to IC_5 for being comparing and amplifying, which is feedback to the operational □ of IC_4 so that after a signal output therefrom is transmitted to pin 10 of IC_1 for being digitally processed, the output current of the driver is regulated so as to stabilize the current for the electric motor;

the comparison amplifier brakes and protects the amplified signal of the circuit, and performs the monitoring for the primary and auxiliary power supplies, where the amplified signal is sent to the Schimit trigging inverter for being signal-shaped, being level transformed and

controlling the trigger, and sent to the CPU for being processed;

the central processing unit performs the systematic control for the whole circuit by means of two programmable micro controlled units IC_1 and IC_2, where IC_1 outputs a set of clock pulse signals for controlling the operation state of the pre-amplifying circuit, controls the primary power supply and receives a trigging pulse for the data exchanging with IC_2 when K_1 is switched off; and IC_2 performs the digitally processing for signal from the signal detector for the position of the motor rotor IC_3, so as to make IC_1 output a set of pulse signals to supply the electricity to the coils of the electric motor and make them conducting in turns, and performs the data exchanging with IC_1, which includes the respective control for the start/stop and braking of the relay, for the overcurrent, the undervoltage and the overvoltage;

the electronic converter (2) is connected to the electric motor (1) and the storage battery (3);

IC_6 is an inverter having the function of Schimit trigger at the input stage thereof, which functions principally for transmitting the respective high levels derived from stepping-down the voltage of 24V from the battery and the voltage of 5V from the switch power to pin 11 and pin 9 of IC_6 respectively for performing the level inverting, where a low level is output from pin 10 and pin 8, and the low level derived from the inverted high level of pin 10 of IC_2 is output from pin 6; the respective control signals transmitted from pin 1, pin 2, pin 13 and pin 14 are shaped and inverted on the other end thereof, and a low level is output for complying the requirement for the interface circuit of IC_7, where the principal functions thereof are level transforming and signal shaping;

IC_7 is a dual D trigger which functions principally for providing a clock control signal for IC_8-IC_{11}, so as to control the switch on and switch off of IC_8-IC_{11}; the respective protecting control signals and braking control signals are transmitted to IC_1, i.e. the CPU, for being digitally processing via the other end, where IC_1 starts the operation when a TTL high level is output from pin 1 of IC_7 to pin 15 of IC_1, and similarly, IC_2 starts the operation when a TTL high level is output from pin 5 of IC_7 to pin 2 of IC_2; pin 3 of IC_7 is a clock input terminal which is provided with a clock signal from pin 9 of IC_2;

IC_8 is a step-up circuit for the primary power supply, which is a parallel switch power actually that keeps the rotation speed of the electric motor and provides the supplemental electricity for the instantaneous potential drop for enhancing the efficiency, and functions for stabilizing the voltage of the power supply when the voltage of the power supply is fluctuating;

IC_9 is a driving circuit for the field effect transistor, which has two terminals for outputting the driving signal, in which only one driving signal is output and two terminals operates alternatively when being in a normal operation, so as to invert the coils A, B and C of the electric motor and provide the electricity therefor in turns for producing a rotation magnetic filed; it has a clock control terminal, i.e. pin 11 thereof, which is controlled by IC_7 and is capable of stopping the outputting of both output terminals, i.e. two field effect transistors of the supply points of the electric motor also stop operating and the supply points of the electric motor are cut off;

the respective working principles of IC_{10} and IC_{11} are similar to that of

IC_9 and are not repeated herein, where IC_9 is driven by the C-phase power, IC_{10} is driven by the B-phase power and IC_{11} is driven by the A-phase power, and the three integrated circuits are operated by the low frequency pulse timing signals respectively output from pin 18 to pin 25 of IC_1.

ELECTRIC ASSISTANCE VEHICLE

The present utility model relates to an electric assistance vehicle.

Presently, there exist various electric assistance vehicles including the electric bicycle provided in the Patent No. 88218203.X, the electric bicycle provided in the Patent No. 93232844.X and the electric assistance vehicle provided in the Patent No. 93232727.8, where the respective structures thereof are relatively complicated. The respective electric motors of the mentioned vehicles are started by the storage battery. All of the used electric motors having brushes are disadvantageous in large attrition and high failure rate, which need to be maintained often, or need to be equipped with a further transmission system for being power-driven, which results in a relatively low transmission efficiency. Furthermore, some need two electric motors, which brings a relatively high production cost and the difficulty in popularization.

One aspect of the present utility model is to provide an electric assistance vehicle that adopts the shaft of a three-phase synchronous brushless and sensorless bi-directional transmission electric motor having a fixed permanent magnet of rare-earth metal to replace the rear axle shaft or the front axle shaft of the typical bicycle. Hence a further transmission system is not necessary, and the transmission and converting efficiency is thus enhanced. The energy is provided by the storage battery while the original transmission system and the original pedaling function of the bicycle are not affected.

The present utility model is composed of a typical bicycle, an electric motor, an electronic converter and a storage battery. The rear axle shaft or the front axle shaft (18) of the typical bicycle is replaced by the shaft (9) of a three-phase synchronous brushless and sensorless bi-directional

transmission electric motor having a fixed permanent magnet of rare-earth metal, which is connected with a fly wheel (4) configured on the right cover (12). The storage battery (3) is configured below the tripod stand and the lower incline grinder (6) or configured on the rear tailstock (19). The electronic converter (2) is configured below the rear ledge. The left and the right brakes (7, 8) are equipped with a respective micro switch. The core (16) and the coil (17) of the electric motor (1) are corresponding to the bicycle frame through the shaft (9) of the electric motor and fixed on the rear tripod stand or the front fork of the bicycle where the coil of the electric motor adopting a double-layer winding and a star wiring composed of four lines, and three of which (A, B, C) are connected to a driver while the neutral one (N) is connected to a signal detecting circuit. The power cord is drawn out via the fixing shaft. The shaft (9) of the electric motor is directly correspondent to each type of bicycle including a 24-inch, a 26-inch and a 28-inch one having a steel wire hole (15) configured outside the magnetic ring (13) as well as the left and the right covers (11, 12), and equipped to the rear or the front steel diskwheel via the steel wire. The left and the right covers are fixed via a bolt hole (14). The circuit for the electronic converter (2) is composed of a power supply, a filter, an auxiliary power supply, a signal detector for the position of the motor rotor, a pre-amplifying circuit, a braking and overcurrent-protecting circuit, a comparison amplifier, an inverter, a trigger and a central processing unit. The primary power supply provides for the electric motor with a battery of 24V through the filter and the power for the primary switch is transmitted via the other end thereof. The filter keeps the input and output currents of the battery at a low-fluctuation state. The auxiliary power supply is composed of a switch power IC, a switch tube and a switch transformer, which outputs four different voltages as a respective operation voltage for all of the ICs and reduces the large

variation in the voltage of the battery as well as the loss produced by the plurality of backup voltages. The signal detector for the position of the motor rotor is composed of IC3 and a matrix of resistors, whereby a pulse signal is picked up from the coil of the electric motor, transmitted to the IC3 for being amplified and sampled, output to the position signal processing unit $CPUIC_2$ for being digitally processed, and then output to the $CPUIC_1$. The pre-amplifying circuit is provided with a pulse shape signal from the IC_1, whereby the pulse shape signal is amplified for further controlling the field effect transistor where eight field effect transistors are fed with 24V and conducting in turns for providing electricity to the coils A, B and C by turns, so as to enable the electric motor. The braking and overcurrent-protecting circuit: when the switch K1 is off, a low voltage level is produced on the operational [illegible] and [illegible]+ terminals at pin 3 and pin 14 of IC_4, a signal voltage is transmitted from pin 1 and pin 14 of IC_4 to pin 10 and pin 14 of IC_1 for being processed, the pulse signals on pin 18 to pin 25 are cut off and thus the power supply of the electric motor is switched off, so as to prevent the damage and the overcurrent of the electric motor caused by the failure thereof, a potential drop crossing the two terminals of RO_1 is produced and transmitted to the operational [illegible] of IC_4 for being compared, a signal voltage output from pin 7 of IC_4 is transmitted to IC_5 for being comparing and amplifying, which is feedback to the operational [illegible] of IC_4 so that after a signal output therefrom is transmitted to pin 10 of IC_1 for being digitally processed, the output current of the driver is regulated so as to stabilize the current for the electric motor. The comparison amplifier brakes and protects the amplified signal of the circuit, and performs the monitoring for the primary and auxiliary power supplies, where the amplified signal is sent to the Schimit trigging inverter for being signal-shaped, being level transformed and controlling the trigger, and sent to the CPU for being

processed. The central processing unit performs the systematic control for the whole circuit by means of two programmable micro controlled units IC_1 and IC_2, where IC_1 outputs a set of clock pulse signals for controlling the operation state of the pre-amplifying circuit, controls the primary power supply and receives a trigging pulse for the data exchanging with IC_2 when K_1 is switched off; and IC_2 performs the digitally processing for signal from the signal detector for the position of the motor rotor IC_3, so as to make IC_1 output a set of pulse signals to supply the electricity to the coils of the electric motor and make them conducting in turns, and performs the data exchanging with IC_1, which includes the respective control for the start/stop and braking of the relay, for the overcurrent, the undervoltage and the overvoltage. The electronic converter (2) is connected to the electric motor (1) and the storage battery (3). IC_6 is an inverter having the function of Schimit trigger at the input stage thereof, which functions principally for transmitting the respective high levels derived from stepping-down the voltage of 24V from the battery and the voltage of 5V from the switch power to pin 11 and pin 9 of IC_6 respectively for performing the level inverting, where a low level is output from pin 10 and pin 8, and the low level derived from the inverted high level of pin 10 of IC_2 is output from pin 6. The respective control signals transmitted from pin 1, pin 2, pin 13 and pin 14 are shaped and inverted on the other end thereof, and a low level is output for complying the requirement for the interface circuit of IC_7, where the principal functions thereof are level transforming and signal shaping. IC_7 is a dual D trigger which functions principally for providing a clock control signal for IC_8-IC_{11}, so as to control the switch on and switch off of IC_8-IC_{11}. The respective protecting control signals and braking control signals are transmitted to IC_1, i.e. the CPU, for being digitally processing via the other end, where IC_1 starts the operation when a TTL high level is output

from pin 1 of IC_7 to pin 15 of IC_1, and similarly, IC_2 starts the operation when a TTL high level is output from pin 5 of IC_7 to pin 2 of IC_2. Pin 3 of IC_7 is a clock input terminal which is provided with a clock signal from pin 9 of IC_2. IC_8 is a step-up circuit for the primary power supply, which is a parallel switch power actually that keeps the rotation speed of the electric motor and provides the supplemental electricity for the instantaneous potential drop for enhancing the efficiency, and functions for stabilizing the voltage of the power supply when the voltage of the power supply is fluctuating. IC_9 is a driving circuit for the field effect transistor, which has two terminals for outputting the driving signal, in which only one driving signal is output and two terminals operates alternatively when being in a normal operation, so as to invert the coils A, B and C of the electric motor and provide the electricity therefor in turns for producing a rotation magnetic filed. It has a clock control terminal, i.e. pin 11 thereof, which is controlled by IC_7 and is capable of stopping the outputting of both output terminals, i.e. two field effect transistors of the supply points of the electric motor also stop operating and the supply points of the electric motor are cut off. The respective working principles of IC_{10} and IC_{11} are similar to that of IC_9 and are not repeated herein, where IC_9 is driven by the C-phase power, IC_{10} is driven by the B-phase power and IC_{11} is driven by the A-phase power, and the three integrated circuits are operated by the low frequency pulse timing signals respectively output from pin 18 to pin 25 of IC_1.

The utility model has a novel design in that the rear axle shaft or the front axle shaft of the typical bicycle is replaced by the shaft of a three-phase synchronous brushless and sensorless bi-directional transmission electric motor having a fixed permanent magnet of rare-earth metal, the storage battery provides the energy therefor and the vehicle is

equipped with the electronic converter. The converting and transmitting efficiency is relatively high, and it is safe to ride this vehicle, where the original transmission system and the original pedaling function are not changed. The vehicle is one of the ideal communications at present.

[BRIEF DESCRIPTION OF DRAWINGS]

Figs. 1(A) and 1(B) are diagrams schematically illustrating the structures of the present utility model;

Fig. 2 is a diagram showing the appearance of the electric motor of the present utility model;

Fig. 3 is a cross-sectional view of the electric motor of the present utility model; and

Fig. 4 is a block diagram showing the electronic converter of the present utility model; and

Figs. 5(I) and (II) are diagrams schematically illustrating the working principles for the electronic converter of the present utility model.

In the present utility model, except for the devices and elements for the electric motor and the electronic converter, all of the devices are applicable and purchasable. According to Fig. 1, the storage battery (3) is configured in a specific battery box and fixed on the tripod stand and the lower incline grinder (6) or configured on the rear tailstock (19). The original rear axle shaft or the front axle shaft (18) of the typical bicycle is replaced by the shaft (9) of the electric motor (1), which is fixed at the respective position of the rear axle shaft or the front axle shaft (18). The original rear flywheel of the bicycle is replaced by the flywheel (4) configured on the flywheel axle shaft on the right cover (12) of the electric motor (1), so as to keeps the original mental transmission system.

The rotation part of the electric motor (1) as well as the left and the right covers (11, 12) are equipped to the rear steel diskwheel for a direct transmission or to the front steel diskwheel via the steel wire. The electronic converter (2) is configured below the rear ledge, whereby the electric motor (1) is connected to the storage battery (3). The electronic converter (2) has a power switch configured thereon. When the bicycle needs to be power-driven, the rider could switch on the power switch and pedal the bicycle for two or three circles, and then the electric motor (1) thereof would be supplied with the electricity by the electronic converter (2). The electronic converter (2) is capable of detecting and logically controlling, so that the electric motor (1) would not be supplies with the electricity when the bicycle stops, even the power switch is on. Accordingly, the static loss in the electric energy is prevented. The left and the right brakes (7, 8) of the bicycle are equipped with the respective micro switches for controlling the speed thereof, which are typically switched on. When the bicycle needs to be speeded down in operating, the power for the electric motor would be cut off whether the front brake and the rear brake are enabled. The power supply for the electric motor would be recovered when the brakes are unbraced. Furthermore, it is convenient to assemble the electric assistance vehicle of the present utility model since the standard bolts are adopted for the connecting parts thereof.