Fully automatic charging system development for electric motorcycles

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ABSTRACT

Due to significant changing in climate and national environmental measures, the efficiency improvement and CO2 reduction become a very important task for the motorcycles industry. Taiwan ’ s motorcycles industry spares no effort to the development of electric motorcycles. The basic characteristics requirement of modern battery for electric motorcycles includes high energy density, fast charge and discharge, high power output, and long cycle life. However, existing two kind of charging systems of electric motorcycles are not so conveniently. First, for the traditional removable battery box design, one should take 5~10 kg battery box and find a charging device to replenish battery capacity. Secondly, plug-in charging design is better than the removable battery box design because we don ’ t need take the heavy battery box. When the electric motorcycle stops, one should find an AC power source and pull the motorcycle plug into the socket. According to this inconvenient fact, it should be pointed out that the two traditional battery charging design must be modify. This thesis has focused on a new design system of fully automatic charging system for electric motorcycles. A novel distributed charging design with SOC balance property is introduced for series connected battery strings. It reaches these functions of improving the storing efficiency and reducing energy losses. Moreover, it can also equilibrium charge at the same time to lengthen the battery life. The fully automatic charging system is divided into three parts: 1.Regenerative braking system: Design a special charging circuit for regenerative braking control of electric motorcycles. The SOC balance function is also established in this charging circuit. 2.Parking stand charging system: When the electric motorcycle stops with the parking stand setting up, a non-directly-contact charging module is designed for the battery charging. By using this charging module, the charging procedure will be automatically running with SOC balance function. 3.Plug-in charging system: Use the same basic circuit structure of the parking stand charging system, plug-in charging system is also designed while stopping the motorcycle. The charge system can replenish battery capacity rapidly. Some basic analysis for a charging system of electric motorcycle is presented. The circuit design of regenerative braking system, parking stand charging system and plug-in charging system will be discussed in detail. Experimental results demonstrated to achieve the objective of the full charging functions.

Keywords : electric motorcycles

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REFERENCES

[1]葉旻彥, 李晉承, 潘善政, 陳宗梁, 王琮民, 李瑞堂, “ 脈寬調變應用於電動車驅動暨充電整合系統之設計 ”, 國立高雄海洋科技大學學報 第二十二期, 2005.

[2]M. Ortuzar, J. Moreno, and J. Dixon,“ Ultracapacitor-based auxiliary energy system for an electric vehicle : implementation and evaluation ”, IEEE Trans. Ind. Electron., vol. 54, no. 4, pp. 2147-2156, Aug. 2007.
[3]洪新堯,“ 電動機車煞車回充電系統設計與研究 ”, 國立台灣大學, 碩士論文, 1999.
[4]許家興,“ 電動車電池類型與電池基礎介紹 ”, 電動車與車輛電子研究報告, 財團法人車輛研究測試中心, 2009.
[5]Battery University,“ What ’ s the best battery? ”, http://batteryuniversity.com/partone-3.htm.
[6]歐陽杰,“ 磷酸鋰鐵電池之分散式充電系統研製與驗證 ”, 碩士論文, 大葉大學, 2010.
[7]A123,“ High Power Lithium IonNR26650M1A ”, http://www.a123system.com/a123/products, 2009.
[8]王昱權,“ PWM/PFM雙模式排程鋰電池充電控制器之設計 ”, 碩士論文, 朝陽科技大學資訊工程系, Jul. 2008.
[9]陳遵立,“ 智慧型鋰離子電池殘存電量估測之研究 ”, 碩士論文, 中山大學電機工程學系, Oct. 2004.
[10]徐乾尊, 劉益華, 李建德,“ 非接觸式鉛酸電池充電器的設計 ”, 中華民國第二十六屆電力工程研討會, pp. 1425-1429, Dec. 2005.
[11]Don A. G. Pedder, Andrew D. Brown, and J. Andrew Skinner“ A Contactless Electrical Transmission System ”, IEEE Transactions on Industrial Electronics, Vol. 46, No. 1, pp. 23-30, Feb. 1999.
[12]李嘉猷,“ 非接觸式感應充電技術應用於可攜式電子產品之研究 ”, 計畫報告, 國立成功大學電機工程學系, 2006.
[13]邱俊翔,“ 非接觸式感應饋電技術應用於鎳鎘電池充電之研究 ”, 碩士論文, 國立成功大學電機工程學系, Jun. 2007.
[14]黃士航,“ 串聯電池組之均勻充電研究 ”, 碩士論文, 彰化師範大學電機工程學系, Jun. 2003.
[15]洪瑋,“ 串聯電池組之平衡放電 ”, 碩士論文, 中山大學電機工程學系, Jul. 2010.
[16]Masatoshi Uno and Koji Tanaka,“ Influence of High-Frequency Charge – Discharge Cycling Induced by Cell Voltage Equalizers on the Life Performance of Lithium-Ion Cells ”, IEEE transactions on vehicular technology, vol. 60, No. 4, May 2011.
[17]宋自恆, 林慶仁,“ 剖析切換式電源供應器的原理及常用元件規格 ”, 新電子科技雜誌第196期, Jul. 2002.
[18]施奕丞,“ 低電壓應力之嶄新單級隔離式高功因電力轉換器之模式分析與控制器設計 ”, 碩士論文, 國立成功大學工程科學系, Jul. 2003.
[19]TOSHIBA, Inc.,“ TLP250 ”, datasheet, www.alldatasheet.net, 2008.
[20]柯紘鈞,“ 電動車60kW輪轂馬達驅動器之設計製造與驗 ”, 碩士論文, 大葉大學, Jun. 2010.
[21]洪振傑,“ 比雅久電動機車之輪轂馬達驅動器研製與實車驗證 ”, 碩士論文, 大葉大學, Jun. 2010.
[22]Topstek, Inc.,“ TES100 ”, datasheet, www.topstek.com, 2008.
[23]Texas Instruments,“ TMS320LF2407A DSP Controllers ”, Texas Instruments Inc., Jul. 2000.
[24]董勝源,“ DSP TMS320LF2407與C語言控制實習 ”, 長高科技圖書, Jun. 2004.
[25]Spectrum digital,“ ezdsp LF2407 ”, spectrum digital Inc., Dec. 2000.