International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 4 Issue 05, May-2015

Experimental Set Up to Demonstrated Role of Flywheel for Increasing Battery Life of Electric Vehicles

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***Abstract*—Electric road vehicles are powered by strong batteries considering their cost life and nature of duty ,researches have been working on acceptable method to increase the battery life with help of supporting system .this article describe the role of flywheel for the purpose .it briefly deals with a laboratory set up to teach this aspect .this, project is on going at GHRCE COLLEGE OF ENGINEERING NAGPUR with a view to demonstrated the system to student for clearer understanding**

Keywords:Flywheel, electric driveline, battery.

1. INTRODUCTION

Battery electric vehicles are on the verge of becoming popular .cost of such heavy duty battery is about 40% of vehicle cost .the duty for such a system is very tough because of to many savior torque fluctuations. Frequent over current have to the supplied by the battery .this reduces the battery life to 18 to 24 months .if a supporting system is added for ensuring that the current supplied by the battery does not exceed the rating ,the battery life can be extended to 36 month

Right now, two such system are usable a one is flywheel and other is supper capacitors this article brefly describes planned system using flywheel. The development in terms of energy density have been terrific in recent year but range and life time are still low as compared to vehicles propelled with conventional combustion engine so to overcome this drawback we are using flywheel with battery, at this condition of that system having a several advantage regarding to it. it not only increase the efficiency but also save the battery life .that system using convertors and control strategies in a system.

With the use of battery there is charging and discharging cycles charging specially when this system is in accelerating mode and flywheel handles the power flow in system discharging. Specially when that cycle decrease the number of charge and discharge cycle ,In braking mode of operation with giving steady state flow, this accelerating and braking mode shocks firstly absorb by flywheel due to this there increase the battery life.

Flywheel plays very important position in system during accelerating and breaking mode of system at this condition that flywheel frequently use .In accelerating mode the function of flywheel is basically to provide the variant power

requested by wheel motor due this battery generate a smother power in output, whereas wheel motor act as generator in breaking mode and this flywheel are responsible for storing and regenerating energy.

In this paper presented some control strategies and some power electronics convertor has been implemented. There required convertors which connected as per specifications of system, it includes DC/DC convertor and AC/DC/AC convertor . Section 2 give the explanation of modeling and working of that convertors. Section 3 giving laboratory model under fabrication ,further it describe that experimental result and hardware with future scope we will discussed.

II OVERVIEW OF APPLICATION OF FLYWHEEL.

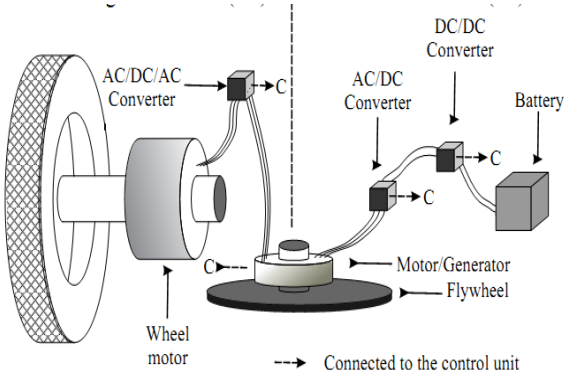

Fig 1: schematic of power flow in both direction of all electric driveline.

As per we known flywheel is energy storage device are classed in group of mechanical energy storage basically it stores a kinetic energy of rotation in system. It is based on the rotating mass principle. A flywheel stores energy depends on moment of inertia and rotational speed of flywheel .

$$K.E=\frac{1}{2}mw^2 \ldots\ldots\ldots(1)$$

Whereas, m is rotating mass of that flywheel.
w is moment of inertia of flywheel.

But novelty of that system here we are using double wound machine which showing that high voltage and low voltage when system at accelerating mode then it work as motor and when it on breaking mode it will work as generator .for that supplying condition we need convertor which connected as shown in fig 1. The system needs a considerable number of power electronics converter and electronics controller to regulate and a optimized the power flux between component It contains that DC/AC convertor connected through battery to low voltage side of flywheel whereas, AC/DC/AC convertor attached to wheel through high voltage side of flywheel. Due to connected flywheel to the system it is efficient and increase battery life.

AC/DC/AC CONVERTOR:

We are be acquainted with that supply is given to the flywheel and generating output is three phase. On this basis the angular speed of given machine is proportional to the electric frequency but at what time when system in steady state condition and energy stored in flywheel. This flywheel rotor is related to the angular speed of system in support of this system the given speed of wheel is vary according to the requirements of system.

This AC/DC/AC convertor is decoupled with two frequencies. And it showing bidirectional so it will work simultaneously inverter and rectifier both. Here having two identical bridge which is three phase according to supply it includes one capacitor, inductor compose in power circuit.

In acceleration mode this two bridge divided in rectifiers and inverters. As shown in fig 2.

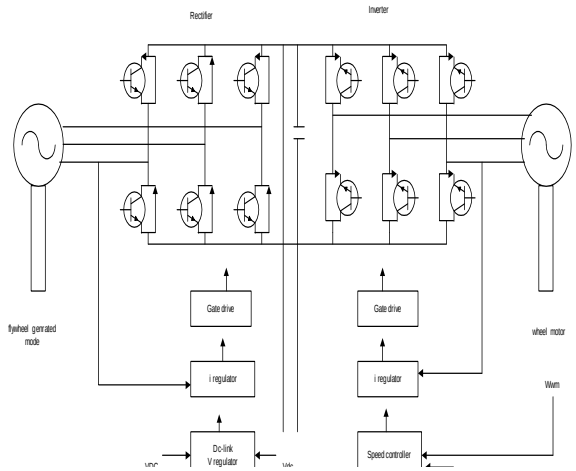

Fig 2: The AC/DC/AC convertor in accelerating mode.

Rectifiers: it will work on forced commuted three phase controlled system it required to obtain desired voltage in dc link for different flywheel of system. The choice of L and C is very important for the advantage of power electronics due to dc link peak more voltage than generated voltage by rectifying diode so that L performs a boost voltage operation in combination with capacitor.

The active power supplied from the source is

$$P = \frac{3}{2}(e_q i_q + e_d i_d) \ldots\ldots (2)$$

Inverter: this inverter is second drive part of convertor it helps to driven wheel motor with controlling its angular speed for different load torque. The electromagnetic torque expressed in frame is given by

$$T = \frac{3p}{2}\left[\varphi_{PM} i_q + i_q i_d \left(L_d - L_q\right)\right] \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Whereas denotes number of pole pair,φ_{pm} is flux produced by permanent magnet with respect to the L_d and L_q.

PROTOTYPE SYSTEM:

The experimental set up shown in fig 3 has been constructed to investigate the prototype flywheel system. This construction allows measurement of complete drive cycle and improving the understanding of constituting component and optimization of complete system.

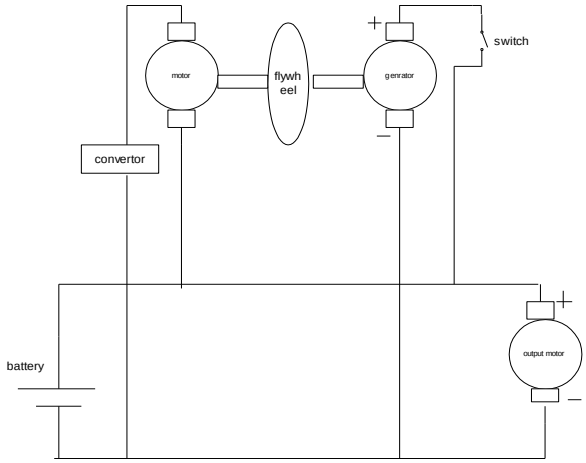

Fig 3: block diagram of purposed prototype

Fig 3: set up of flywheel with motor and generator.

CONCLUSION:

Purpose of fabrication and completion of experimentation is to understand the role of Flywheels for Cars of the coming decade.

FUTURE SCOPE:

This system has to be compared with its competitor, namely the Super capacitors.

REFERENCES:

(1) Goncalves de Oliveria, J.2011 "Power Control System in flywheel based all –electric driveline." acta universitatis upsaliensis.digital comprehensive summaries of uppsala dissertation from the faculty of science and technology 844.102pp.Uppsala. ISBN 978-91-554-8133-9

(2) Hans Bernhoff ,Janaína Oliveira "Power electronics and control of two-voltage-level flywheel based all-electric driveline "Division for Electricity, Dep. of Eng. Sciences, Uppsala University 978-1-4244-9312-8/11/$26.00 ©2011 IEEE.

(3) Santiago, G. Oliveira1, J. Abrahamsson1, A. Larsson and H. Bernhoff "Design Parameters Calculation of a Novel Driveline for Electric Vehicles." *Uppsala University* World Electric Vehicle Journal Vol. 3 - ISSN 2032-6653 *May 13-16, 2009 Division for Electricity, Dep. of Eng. Sciences,*

(4) A. Emadi, S. S. Williamson and A. Khaligh, "Power electronics intensive solutions for advanced electric, hybrid electric, and fuel cell vehicular power systems", IEEE Transactions on Power Electronics, vol. 21, no.3, May 2006.

(5) J. Santiago, J. Oliveira, J. Lundin, , H. Bernhoff, *Losses in Axial-Flux Permanent-Magnet Coreless Flywheel Energy Storage Systems*, Proceedings of the 18th International Conference on Electrical Machines, Vilamoura, Portugal, 2008.

(6) P.Mellor, N. Schofield, D. Howe, "Flywheel and supercapacitor peak power buffer technologies", IEE Colloquium, v 50, n 11, 2010,

(7) C. Marchand & X. Liu, D. Diallo" *Design methodology of fuel cell electric vehicle power system.",* IEEE International Conference on Electrical Machines, Portugal, 2008.

(8) Y. Hori, "Application of Electric Motor, Supercapacitor, and Wireless Power Transfer to enhance operation of future vehicles", IEEE International Symposium on Industrial Electronics (ISIE), 2010, pp. 3633 - 3635.

(9) X. Fu,"The control strategy of flywheel battery for electric vehicles", IEEE International Conference on Control and Automation, 2007, pp. 492-496.

(10) U. Shaible, B. Szabados, "A torque controlled high speed flywheel energy storage system for peak power transfer in electric vehicles", Industry Applications Society Annual Meeting, v 1, 1994, pp. 435-442.

(11) B .Szabodos, U. Schaible, "Peak power bidirectional transfer from high speed to electrical regulated bus voltage system: a practical proposal for vehicular technology", IEEE Transactions on Energy Conversion, 1998, Issue 1, pp. 34-41.

(12) J. Santiago, J. G. Oliveira, J. Lundin, J. Abrahamsson, A. Larsson, H. Bernhoff, "Design parameters calculation of a novel driveline for electric vehicles", World Electric Vehicle Journal Vol. 3 ISSN 2032-6653 - 2009 AVERE.

(13) J. Santiago, A. Larsson, H. Bernhoff (2010) "Dual Voltage Driveline forVehicle Applications," International Journal of Emerging Electric Power Systems: Vol. 11: Iss. 3, Article 1.

(14) M. Hedlund, J. G. Oliveira, H. Bernhoff, "A 4 Quadrant DC/DC Converter Sliding Mode Control System for a Flywheel application" *(to be submitted).*

(15) W. Chien; Y. Tzou; "Analysis and design on the reduction of DC-link electrolytic capacitor for AC/DC/AC converter applied to AC motor drives", Power Electronics Specialists Conference, 1998, Page(s): 275 - 279 vol.1.

(16) M. H. Rashid, *Power Electronics Handbook*, Academic Press, 2001.

(17) J. Abrahamsson, J. Santiago, J. G. Oliveira, J. Lundin, H. Bernhoff, "Prototype of electric driveline with magnetically levitated double wound motor", Proceedings of the International Conference on Electrical Machines (ICEM), 2010.

(18) J.G.Oliveria,H.schettino, V.GAMA,R.Carvalho –"Implimentation and control of an AC/DC/AC/ converter for double wound flywheel applications" *1Division for Electricity, Uppsala University, 751 05 Uppsala, Sweden 2 Electrical Engineering Department, Federal University of Juiz de Fora, 36036-900 Juiz de Fora, MG, Brazil.*

(19) *Yi Feng*, Heyun Lin*, Jianhu Yan†, Yujing Guo*, Xiaoquan Lu*, Hui Yang**- "A Novel Control Strategy for BLDCM Applied in Flywheel Energy Storage System Based on Unipolar and Bipolar Control" *Engineering Research Center for Motion Control of Ministry of Education, Southeast University, Nanjing 210096, P. R. China*