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 describes the role of flywheel for the purpose. It briefly deals with a laboratory set up to teach this aspect. This project is 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 many savior torque fluctuations. Frequent over current have to be 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 one is flywheel and other is supper capacitors. This article briefly 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.

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.

\[ K.E = \frac{1}{2}m\omega^2 \]
Whereas, \( m \) is rotating mass of that 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 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.

Rectifiers: it will work on forced commuted three phase controlled system it required to obtain desired voltage in dc link for different load torque. The electromagnetic torque expressed in frame is given by

\[
T = 3p \left[ \varphi_{pm}i_q + i_qi_d \left( L_d - L_q \right) \right] \quad \cdots \cdots \cdots (3)
\]

Whereas \( p \) denotes number of pole pair, \( \varphi_{pm} \) 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](image)

![Fig 3: set up of flywheel with motor and generator](image)
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.

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