Flywheel as Energy Storage Device

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Abstract- In flywheel based energy storage systems, a flywheel stores mechanical energy that interchanges in form of electrical energy by means of an electrical machine with a bidirectional power converter. Flywheel based energy storage systems are suitable whenever numerous charge and discharge cycles (hundred of thousands) are needed with medium to high power (kW to MW) during short periods (seconds). The materials for the flywheel, the type of electrical machine, the type of bearings and the confinement atmosphere determine the energy efficiency (>;85%) of the flywheel based energy storage systems. Monitoring of state of charge is simple and reliable as only spinning speed is needed. Flywheel based energy storage systems are commercially available with more than a dozen of manufacturers. Amongst the applications of flywheel based energy storage systems are: uninterruptible power supplies, hybrid power systems, power grids feeding trains, hybrid vehicles and space satellites.

I. INTRODUCTION

Flywheel energy storage systems (FESS) use electric energy input which is stored in the form of kinetic energy. Kinetic energy can be described as "energy of motion," in this case the motion of a spinning mass, called a rotor. The rotor spins in a nearly frictionless enclosure. When short-term backup power is required because utility power fluctuates or is lost, the inertia allows the rotor to continue spinning and the resulting kinetic energy is converted to electricity. Most modern high-speed flywheel energy storage systems consist of a massive rotating cylinder (a rim attached to a shaft) that is supported on a stator – the stationary part of an electric generator – by magnetically levitated bearings. To maintain efficiency, the flywheel system is operated in a vacuum to reduce drag. The flywheel is connected to a motor-generator that interacts with the utility grid through advanced power electronics.

II. LITERATURE REVIEW

[1] "Hybrid PV System with High Speed Flywheel Energy Storage for Remote loads"

1. Aerodynamic drag and bearing friction are the main sources of standby losses in the flywheel rotor part of a flywheel energy storage system (FESS). Although these losses are typically small in a well-designed system, the energy losses can become significant due to the continuous operation of the flywheel over time.

[2] "Development of a High-Fidelity Model for an Electrically Driven Energy Storage Flywheel"

1. Energy storage systems (ESS) are key elements that can be used to improve electrical system efficiency by contributing to balance of supply and demand. They provide a means for enhancing the power quality and stability of electrical systems. They can enhance electrical system flexibility by mitigating supply intermittency, which has recently become problematic, due to the increased penetration. Flywheels configured for grid connected operation are systems comprising of a mechanical part, the flywheel rotor, bearings and casings, and the electric drive part, inclusive of motor-generator (MG) and power electronics. This contribution focusses on the modelling and simulation of a high inertia FESS for energy storage applications which has the potential for use in the residential sector in more challenging situations, a subject area in which there are few publications. The type of electrical machine employed is a permanent magnet synchronous motor

(PMSM) and this, along with the power electronics drive, is simulated in the MATLAB/Simulink environment. A brief description of the flywheel structure and applications are given as a means of providing context fluctuation.

[3] “Comparison of Performance and Controlling Schemes of Synchronous and Induction Machines Used in Flywheel Energy Storage Systems”

For stable operation of the electrical grid, it is vital to maintain a balance between demand and supply of electrical power. Imbalance at any instant between consumption and generation causes voltage and frequency instability. Intermittent generation (wind and solar) in power systems is more likely to cause such imbalance hence frequency and voltage variations. To address the stability issues due to integration of intermittent renewables in to the grid, a storage device are required which can quickly respond to the power variations. A Flywheel Energy Storage System (FESS) has the capability to respond within a sub-second timescale and is able to balance power variations. The performance of FESS is highly dependent on the type of motor/generator (MG) set which is the key component to generate or consume power from grid. The three main types of electrical machines used in FESS applications are synchronous machine (SM), induction machine (IM) and switched reluctance machine (SRM). Switched reluctance is not as commonly used due to high current ripples and complex torque control [1]. SM is used for high speed applications due to its high efficiency and IM is used for high power applications due to its rough construction. This research focuses on comparison of synchronous and induction machines used in kinet

III. METHODOLOGY

Flywheel energy storage is a smart method for storing electricity in the form of kinetic energy. The idea behind this technology is that the surplus electricity to be stored drives a motor that spins a flywheel thousands of rounds per minute to store kinetic energy. The flywheel moves easily because of being levitated in an evacuated chamber with magnets and highly efficient bearings. The stored kinetic energy is the momentum of the flywheel and can actuate an electricity generator as another part of the system to produce power. Low maintenance costs, a long expected lifetime, fast response, and roundtrip efficiency of about 90% are of the main advantages of flywheel systems.

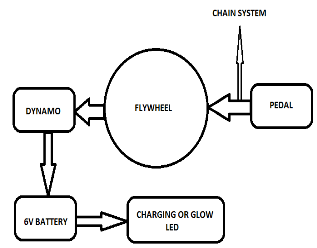

Fig.1. Block Diagram

A. Working:

To generate a non-conventional power using solar wind and other resources were already we are using this project we are showing how to generate the non-conventional power using are free wheel R A flywheel using a cycle Rim as a flywheel and pedal mechanism with a chain system to drive the flywheel easily. flywheel is connected to a round belt conveyor to a Dynamo which start to generate a DC power and this power is stored in the battery dynamo is a small 5 at power output it and provides a DC voltage directly this DC voltage is stored in the lead acid rechargeable battery which is at 6 volts 4 a h and the Stored energy can be utilized for other application.

The cycle wheel Rim which acts as a flywheel and the dynamo which is shafted or connected through a belt rotate with one is to 20 Revolution which is a mechanical magnification and with the help of one pedal rotation it is possible we can generate a huge amount of power and this power can be possible to store in a lead acid rechargeable battery. Now the stored energy is used for two major application to run LED lights and also to charge the mobile phone using a special 5 volt regulator circuit for running a LED lights the Stored battery voltage can be directly utilized to run a white or red LED which illuminate and provide the sufficient brightness in the location to charge the mobile we are using a 7805 voltage regulator which provides a 5 volt and the safe voltage to the mobile charging socket which is possible to charge any model mobile also.

To charge the lead acid battery with other resources like a electric power we are using a step down Transformer of 9 volt with the 500 mA which provides an AC voltage at 9 v and now this voltage convert from AC to DC using two diodes as a rectifier full wave and with the help of a filter capacitor we are removed the pulsating ripples in the voltage and now this voltage is possible.

IV. RESULT

The main result or the otecome is the electrical energy which can stored in the battery and used for the charging purpose or the street light purpose.

CONCLUSION

This paper has presented a critical review of FESS with reference to its main components and applications

The structure and components of the flywheel are introduced and the main types for electric machines, power electronics, and bearing systems for flywheel storage systems are described.

Transportation, renewable energy systems, and energy storage are explained, and some commercially.

Available flywheel storage prototypes, along with their operation under each application, are also mentioned.

FESS offer the unique characteristics of a very high cycle and calendar life, and are the best technology for applications which demand these requirements.

A high power capability, instant response, and ease of recycling are additional key advantages. Given the demand for ESS is expanded.

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