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STUDY OF FLYWHEEL SOLAR ENERGY STORAGE SYSTEM

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ABSTRACT

The purpose of this design was to construct and test an off-grid photovoltaic (PV) system in which the power from a solar array could be stored in a rechargeable battery and a flywheel motor- creator assembly. The mechanical flywheel energy storehouse system would in turn effectively power a 12-volt DC appliance. The voltage and current of different sword flywheel density were measured versus time for two different cargo settings on a 12-volt DC addict. The off-grid PV system was plant to be functional in storing and discharging power, especially during quick discharges. Although not the most effective system of energy storehouse, this outfit shows great pledge for energy storehouse when further tested and bettered. This paper presents an abstract study and illustrations of FES units. After a brief preface to the FES system and its proposition of operation, the paper focuses on the important part of the FES system in enhancing the operation of the distribution network. Supported by illustrated circuits, the FES system in the enhancement of the power quality of the network. A flywheel energy storehouse technology was ended, with a special focus on the progress in automotive operations. To ameliorate the effectiveness and continuance, also it discusses a recently proposed design of the FES system that surfaced lately, which includes the use of Superconducting Glamorous Bearings (SMB) and Endless Glamorous Bearings (PMB). In conclusion, the paper analyzes the FES systems great capabilities that could be exploited in perfecting the trust ability of the electrical system.

Keywords: Flywheel Solar Energy Storage System (FSESS), CFC (Carbon Fiber Composites), Flywheel, Energy Storage, High-Speed, Composites; Energy Density.

1. Introduction: Flywheel solar energy storehouse systems (FESS) use electric energy input which is stored in the form of kinetic energy. Kinetic energy can be described as “energy of stir,” in this case the stir of a spinning mass, called a rotor. The rotor spins in a nearly amicable quadrangle. When short- term backup power is needed because mileage power fluctuates or is lost, the indolence allows the rotor to continue spinning and the performing kinetic energy is converted to electricity. Utmost ultramodern high-speed flywheel energy storehouse systems correspond of a massive rotating cylinder (a hem attached to a shaft) that's supported on a stator the stationary part of an electric creator by magnetically levitated comportments. To maintain effectiveness, the flywheel system is operated in a vacuum to reduce drag. The flywheel is connected to a motor creator that interacts with the mileage grid through advanced power electronics. Some of the crucial advantages of flywheel energy storehouse are low conservation, long life (some flywheels are able of well over full depth of discharge cycles and the newest configurations are able of indeed further than that, lesser than full depth of discharge cycles), and negligible environmental impact. Flywheels can bridge the gap between short- term lift-through power and long- term energy storehouse with excellent cyclic and cargo following characteristics. Generally, druggies of high- speed flywheels must choose between two types of skirtings solid sword or carbon compound. The choice of hem material will determine the system cost, weight, size, and performance. Composite skirtings are both lighter and stronger than sword, which means that they can achieve much advanced rotational pets. The quantum of energy that can be stored in a flywheel is a function of the forecourt of the RPM making advanced rotational pets desirable. Presently, high- power flywheels are used in numerous aerospace and UPS operations. The lamp power systems product 2 kW/ 6 kWh systems are being used in telecommunications operations. For mileage scale storehouse, a'flywheel ranch' approach can be used to store megawatts of electricity for operations demanding twinkles of discharge duration.

1.1 Main factors:

The main factors of a typical flywheel A typical system consists of a flywheel supported by rolling-element bearing connected to a motor creator. The flywheel and occasionally motor creator may be enclosed in a vacuum chamber to reduce disunion and reduce energy loss. First- generation flywheel energy- storehouse systems use a large sword flywheel rotating on mechanical comportments. Newer systems use carbon- fiber compound rotors that have an advanced tensile strength than sword and can store much further energy for the same mass. To reduce disunion, glamorous comportments are occasionally used rather of mechanical comportments.

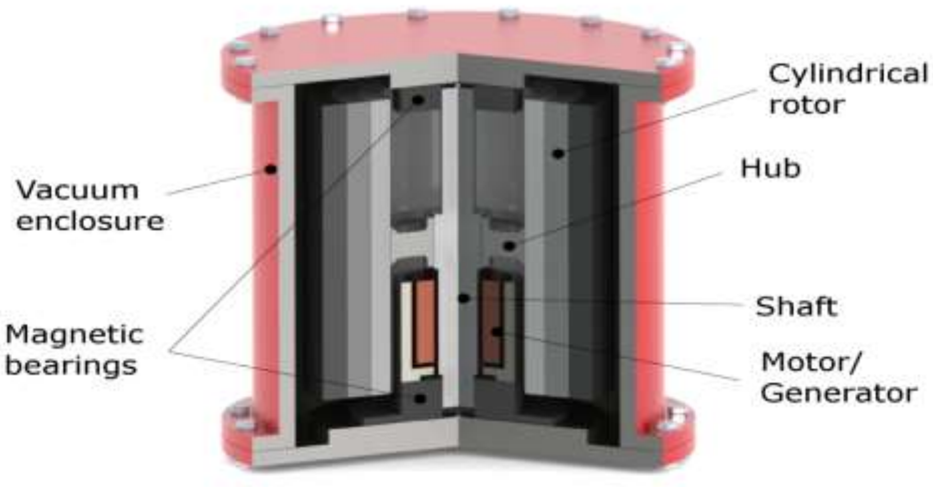

Figure 1. The main components of a typical flywheel

2. EXPERIMENTAL MATERIALS

Flywheels are made from numerous different accoutrements; the operation determines the choice of material Cast iron flywheels are used in old brume machines. Flywheels used in auto machines are made of cast or nodular iron, sword or aluminum. Flywheels made from high- strength sword or mixes have been proposed for use in vehicle energy storehouse and retardation systems. The effectiveness of a flywheel is determined by the maximum quantum of energy it can store per unit weight. As the flywheel's rotational speed or angular haste is increased, the stored energy increases; still, the stresses also increase. Carbon sword 1065, Alloy sword AISI 4340, Maraging sword 18ni, Alloy sword AISI E9310 and Stainless sword this material is also used for flywheel. In future more suitable accoutrements and parcels will be chosen for analysis which will give more accurate results and the same system can be applied for selection of accoutrements for other operations. A fuzzy number is a volume whose value is squishy. Any fuzzy number can be defined as a function whose sphere is a specified set. In numerous situations, fuzzy figures depict the physical world more really than any single valued figures. Fashion for order of Preference by Similarity to Ideal Solution (TOPSIS) is one of the well- known styles in Multiple Trait Decision- Making (MADM). TOPSIS in a fuzzy terrain is where the vagueness and subjectivity are handled with verbal terms and parameterized by triangular fuzzy number. A fuzzymulti-criteria decision analysis system grounded on the generalities of ideal andantiideal points used in fine model of verbal variable.

Materials	**M(KJ/Kg)**	**Comment**
Ceramics	200-2000 (Compression Only)	Brittle And Weak In Tension
Composites : CFRP GFRP	200-500 100-400	The Best Performance— A Good Choice. Almost As Good As CFRP And Cheaper. Excellent Choice.
Beryllium	300	Difficult To Work And Toxic
High Strength Steel	100-200	Good But Expensive. All About Equal In Performance Steel And Aluminum Alloys Cheaper Than Mg And Ti Alloys
High Strength Aluminum Alloys	100-200	
High Strength Mg Alloys	100-200	
High Strength Ti Alloys	100-200	
Lead Alloys	3	Higher Density Makes A Good (And Traditional) Selection When Performance Is Velocity Limited Not Strength Limited

3. EXPERIMENTAL METHODOLOGIES:

The first step involved assembling the photovoltaic system and charging the battery as well as connecting the system using applicable wiring and connectors. Relate to the Figure below for the circuit layout. A 10-watt monocrystalline solar panel was placed on a cookbook stand at an angle of 60 degrees for optimum sun during the fall and downtime. The solar panel was connected to a 7-amp charge regulator to help overcharging the battery, with the charge regulator connected to a 12-volt 8 AH sealed super eminent acid battery placed in a vented battery box. Two three- way switches were connected via a labelled terminal to control the direction of the current. The flywheel motor assembly was connected to the common outstation on the alternate switch. The assembly comported of an atomic 12-volt DC motor permanently attached to a 0.25-in. thick, 6-in. periphery, sword base plate, upon which three removable sword plates, each 6-in. in periphery of the varied consistence (0.25- clout,0.50- clout, and0.75-in.), could be attached. An essence squirrel pen girdled the flywheel motor assembly to serve as a safety guard in case the plate came off balance on the motor axis and spun off. The cargo (a 12-volt “ Tornado” addict) was connected by using a 4-socket auto appendage. Originally, it was planned to use a 60-watt light bulb as the cargo. Still, due to voltage harpoons from the flywheel motor assembly being rejected by the AC-DC inverter, the cargo was changed to a 12-volt DC addict. All factors were connected to a common ground wiring system and mounted onto a rustic underpinning/ display board. 14 Hand insulated bobby electrical wiring (maximum. 32 amps) and line connectors were used for connections. A videotape camera, camera, digital multimeter, and timekeeper were used to record data. Microsoft Excel and Logger Pro were employed for data analysis. In terms of safety, a pukka electrical mastermind approved the design. The battery was noway opened and the voltage and current of both the battery and solar panel were constantly covered. Generous size estimations and insulated tools were used as well. Also, gloves and safety spectacles were worn during testing.

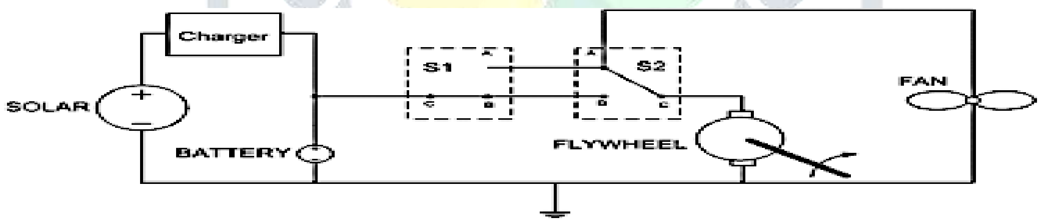

Figure 2: Schematic Drawing of DC Load System

3.1 Testing: For each test, a check from the battery directly to the cargo (addict) was made originally to insure proper connections. The videotape camera was set to record the timekeeper and multimeter readings during the tests. The flywheel was charged from the battery for 30 seconds grounded on when the current would generally table. After 30 seconds, the switches were reset to allow the flywheel to discharge to the addict. Each flywheel size (base plate only, base plate plus0.25-in. plate, base plate plus0.50-in. plate, and base plate plus0.75-in. plate. Three trials were made for each test to help bias. During both charge and discharge, the following measures were made (see Figure 1 for locales of measures) Voltagevs. Time for no, low, and high settings on the addict. The multimeter leads were placed on common (S1) and ground (S2).

3.2. Current vs. time for low and high settings on the addict.

The multimeter leads were placed on common (S1) and B (S2) during charging, also common (S1) and A (S2) during discharging. After each trial, once the flywheel had stopped spinning the switch line from the battery was dis- connected and covered with electrical video. Photos of the set-up were taken and compliances were recorded. Throughout testing, all system factors were routinely checked for safety. A flywheel is basically a mechanical battery conforming of a mass rotating around an axis. It stores energy in the form of kinetic energy and works by accelerating a rotor to veritably high pets and maintaining the energy in the system as rotational energy. Flywheel energy storehouse is a promising technology for replacing conventional lead-acid batteries as energy storehouse systems. Utmost ultramodern high- speed flywheel energy storehouse systems (FESS) correspond of a huge rotating cylinder supported on a stator (the stationary part of a rotary system) by magnetically levitated comportments. These comportments are endless attractions that support the weight of the flywheel by aversion forces and are stabilised with electromagnets.

4. RESULT & DISCUSSION

After all the tests were completed, the video were watched and data collected in Microsoft Excel. The pars of the three trials for the test each were calculated. Also a smatter plot was made to show the voltage for no cargo, the voltage and current for low cargo, and the voltage and current for high cargo versus time for each plate. Relate to Figure 4.1 (a) for the 0.25-in. plate illustration. The voltage and current values were multiplied to make an alternate smatter Plot showing the advised power used and produced by the flywheel during both low and high cargo cases. Relate to Figure4.1 (b) Smatter plot of the advised power wind for low and high cargo for0.25 in. plate. Vernier Logger Pro was used to calculate the integral (area under the wind) of the power versus time angles to determine the measured flywheel energy input and affair for both the low and high power cases for each flywheel size. The theoretical energy stored in the flywheel for each flywheel mass was also calculated by exercising the Voltage & current for0.25 in. plate.

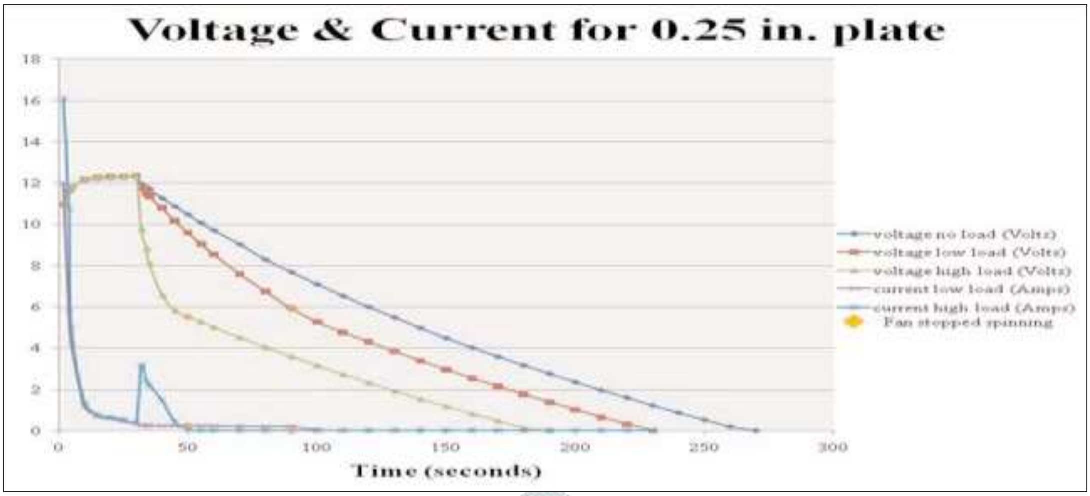

Figure 3: *Scatter plot showing averaged voltage and current values vs. time for all load settings for 0.25 in. plate.*

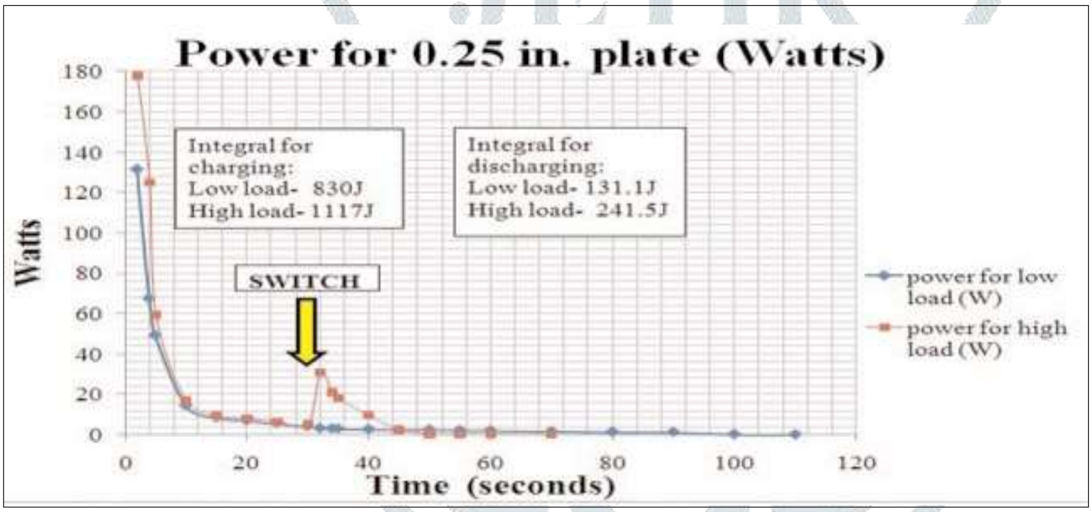

Figure 4: *Scatter plot of calculated power curve for low and high load for 0.25 in. plate*

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