



Designing A Flywheel And Spring Hybrid Device As An Alternative Energy Generating System

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Abstract

Original Research Article

The proposed mechanical energy generating system is a hybrid system that harnesses mechanical energy stored in flywheels and springs to generate alternative energy that is capable of eliminating reliance in fossil fuel-based energy generators. This proposal presents a novel approach to sustainable energy generation through the design and development of a flywheel and spring energy system. This project when completed will serve as a source of alternative clean energy source that is capable of mitigating environmental impact. A comprehensive review of existing energy generation systems and mechanical energy storage technologies informed the design and optimization of the proposed system. Key performance parameters, including energy storage capacity, power output and efficiency will be evaluated through simulations and experimental testing. The results will demonstrate the potential of the flywheel and spring energy generating system to achieve high efficiency and reliability, making it a viable option for replacing conventional energy solutions, promoting a cleaner, sustainable and more environmentally friendly energy future. The system will be designed in such a way to involve the connection between the spring and the flywheel in order to utilize the elastic nature of the spring and its ability to resist an external extension force resulting from the rotation of the flywheel which can be set to be in continuous rotation due to the action of the crank mechanism mounted as a link between multiple springs and the flywheel. These will enable the device to continue rotating and running to generate free, clean and alternating energy when the flywheel is connected to any generator. The whole process is reliable and continuous until a brake system is used to halt its movement.

Keywords: Flywheel energy storage, spring-assisted power generation, alternative energy systems, sustainable mechanical energy, clean energy technology.

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1.0 Introduction

The reality of the climate change is confronting humanity on a daily basis and this in turn has increased the global concern over climate change, environmental pollution, and the call for reduction and elimination of non-renewable

energy sources such as fossil fuels is gaining momentum as the day goes by. There is an urgent need for more sustainable and eco-friendly alternative energy sources that are renewable. Among the renewable energy sources, mechanical energy storage systems have shown



potential in providing efficient, environmentally friendly energy solutions. This project proposes the design and development of a “flywheel and spring energy generating system” that will replace conventional electrical and fossil fuel-based generators, focusing on efficiency, sustainability, and environmental friendliness.

Flywheels and springs are mechanical devices that store energy through rotational or elastic potential energy. Flywheel and Spring Energy Storage Systems (FSESS) is a sustainable energy storage source as it is environmentally friendly, can sustain infinite charge/discharge cycles and has a high power-to-weight ratio in comparison to chemical batteries (T.A. Aanstoos et al, 2015). A flywheel is a mechanical battery that is made up of a spinning mass around an axis. The flywheel works through the principle of storing energy in the form of kinetic rotational energy while Spring as a mechanical device works with the principle of providing the sufficient energy that is equivalent to the external applied forces that result to extension of the Spring with its ability to repeatedly produce this energy is as much as it is constantly engaged with the application of the external applied force. This project seeks to harness the mechanical properties of flywheels and springs to provide a viable alternative energy generation system capable of replacing conventional sources. The proposed system can serve applications ranging from backup power supply to small-scale energy generation, significantly reducing environmental impact while improving efficiency.

4.0 Literature Review

In recent years, mechanical energy storage systems, including flywheels and springs, have been gaining attention as viable alternatives to traditional energy storage systems. Flywheels are mechanical devices that store energy in the form of rotational kinetic energy, and they have been widely researched in the field of energy storage for their high power density, long lifespan, and low environmental impact. However, challenges such as frictional losses and the need for high rotational speeds still exist (N. Z. Nkomo1, A. A. Alugongo, 2024).

Springs, on the other hand, have been

used for centuries as energy storage devices, particularly in applications such as clocks and mechanical toys. The potential energy stored in a compressed or extended spring can be converted into mechanical work with high efficiency. Recent developments in spring-based energy systems have focused on improving the design of springs for energy harvesting and storage, with an emphasis on optimizing their elasticity and minimizing energy loss.

The combination of these two systems in a hybrid model could provide a unique solution for energy generation that is both sustainable and efficient. Previous studies on hybrid energy storage systems, such as those involving flywheels and batteries, have demonstrated the feasibility of combining different energy storage methods to achieve greater efficiency and longevity. This project builds on these studies, with the goal of creating a hybrid flywheel and spring energy system that can replace electrical and fossil fuel generators. Flywheels have been used traditionally to smoothen out fluctuations in irregular drive mechanics. However, flywheel systems are gaining traction due to advancements in the technology of magnetic bearings, the material of flywheel and drive systems (Shafiqur Rehman, et al.,2015)

5.0 Methodology

The project will be carried out in several stages as highlighted below:

1. Design Phase:

- ❖ **Flywheel Design:** The flywheel will be designed using materials with high energy storage capacity and low friction characteristics (e.g., carbon fiber composites). The dimensions, weight, and rotational speed will be optimized to store the required amount of energy.
- ❖ **Spring Design:** A high-performance spring system will be selected and designed based on material properties (e.g., steel or titanium alloys), ensuring that it can store energy efficiently and have a long lifespan.
- ❖ **Hybrid System Design:** The flywheel and spring systems will be integrated to form

a hybrid energy generation unit. The systems will be connected in such a way that they can work in tandem to provide a stable and reliable energy output.

2. Prototype Development:

- ❖ Construction: The components for the flywheel, spring, and associated mechanical systems will be fabricated and assembled into a working prototype.
- ❖ Energy Storage and Release: The system will be tested for energy storage capacity, efficiency, and release of stored energy.

3. Testing and Evaluation:

- ❖ Performance Testing: The system’s efficiency, energy output, and duration of operation will be measured under various load conditions.
- ❖ Comparative Analysis: The performance of the flywheel and spring system will be compared to conventional fossil fuel and electrical generators to assess its efficiency, sustainability, and cost-effectiveness.

4. Environmental Impact Assessment:

- ❖ Emissions Reduction: The environmental impact of using the flywheel and spring system will be evaluated in terms of carbon emissions reduction compared to fossil fuel-based generators.
- ❖ Lifecycle Assessment: The overall environmental footprint of the system, including manufacturing, operation, and disposal, will be analyzed.

5.0 Result

The expected outcomes of this project are:

- ❖ A functional hybrid energy generation system that combines the flywheel and spring mechanisms for efficient energy storage and release.
- ❖ A significant reduction in the environmental footprint compared to conventional fossil fuel-based generators.
- ❖ An evaluation of the system’s efficiency, cost-effectiveness, and reliability in real-world applications.
- ❖ Recommendations for the integration of flywheel and spring energy systems into sustainable energy grids or as standalone backup generators.

5.1 Workplan and Timeline

WORKPLAN AND TIMELINE		
S/NO.	STAGE	DURATION
1	Literature Review	1 month
2	Design of Flywheel and Spring	2 months
3	Prototype Development	3 months
4	Testing and Evaluation	2 months

5	Final Report and Analysis	1 month
6	Total Duration	9 month

5.2 Budget Estimate:

The estimated budget for this project includes:

- ❖ Materials for flywheel and spring fabrication: USD35

Equipment for testing and evaluation: USD15

- ❖ Labor costs: USD20
- ❖ Miscellaneous expenses (e.g., software, transportation): USD15
- ❖ **Total Estimated Cost:** USD35 + USD15 + USD20 + USD15 = USD85

6.0 Conclusion

This project aims to design and develop an innovative flywheel and spring energy generating system that can replace conventional fossil fuel and electrical generators. By combining sustainable energy storage mechanisms with a focus on efficiency and environmental friendliness, the proposed system will contribute to the global transition towards renewable and eco-friendly energy solutions. Through rigorous testing and performance evaluation, the project will provide valuable insights into the potential of mechanical energy storage systems for the future of energy generation. This system when completed can be used as generating energy source to drive numerous machine element with the aid of belt and pulley drive mechanism.

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