International Journal of Engineering & Technology, 7 (3.29) (2018) 568-570

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Design, fabrication and experimentation of swing electricity power generation system

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Abstract

Energy need of today's world is growing day by day because of consumption of larger extent of electricity due to growing population. Project is about generation of electricity by swing. Large number of children play in a playground, part of the power of their play caused by swing can be usefully harnessed resulting in significant energy storage. Yielded energy can be converted to electrical energy to be utilized for many applications. Oscillatory motion of swing is transferred to shaft attached, which further transfers its angular motion to rotary motion of the flywheel, rigidly connected at the end. The flywheel is connected to a generator by specific transmission to conserve and increase the speed at generator end. The generator converts the mechanical energy into electrical energy to be utilized for many applications. Current swing is able to generate enough electricity to power a 15 W DC fan and a 9 W DC bulb. The method provides a low-cost, low-resource means of electricity generation, especially for use in developing countries.

Keywords: *Electricity Generation; Swing, Battery; Alternative Energy; Cheap and Low Resource.*

1. Introduction

The major concern of the today's world is energy crisis [1-5]. The natural resources are limited which are used to power industrial society because of rising demand day by day. Energy crisis is due to the limited utilization of renewable and alternate energy sources [6-7]. The coal fired plants are extensively used across the globe to about 41% for electricity generation but leads to severe environmental problems [8-9]. So, by setting our energy trend towards the use of renewable and alternate energy sources, we can overcome the energy crisis as well as environmental pollution in an efficient way [10].

There is a lot of availability of mechanical energy in the environment which can be converted to other forms like electrical energy [11]. Like in a playground, the swings can be efficiently harnessed producing significant energy storage. Hence, an optimal designing of Swing electricity generation system has huge energy saving potential [12-14].

The main objective of the project is to convert the mechanical energy caused by the swinging action of the swing to electrical energy with the help of different mechanical linkages i.e. sprockets and flywheel.

To get the energy output from this type of system in which energy is going to be wasted for in vain is a big achievement.

2. Working principle

The motion of swing in the forward and backward direction causes the shaft to rotate at an angle. The shaft is supported by the bearings at both ends. The sprocket is attached at one side of the shaft which rotates when the shaft turn through an angle. The compound system used is shown in the fig 1. The sprocket sets transmits the power to the flywheel using the compound system shown. The flywheel conserves and increases the speed of the attached shaft. Another chain and sprocket set is used to convert the motion of flywheel to the generator shaft. The generator shaft rotates and produces electricity which can be stored in the battery which in turn can be used for numerous useful applications.

2.1. Additional feature

The system comprises of the two ratchets attached on the flywheel shaft. The both ratchets are attached at the same axis with the opposite rotating axis as seen in the Figure 1. On the forward motion of the swing first ratchet works and transmits power to the flywheel and the second ratchets moves free. On the contrary, the second ratchet works and first moves free. So the flywheel gets the torque on the both directions i.e. forward and backward. By this principal, more rpm is maintained at the generator end yielding the electricity generation at a larger rate because flywheel is getting torque for both directions instead of one used commonly.

Fig. 1: Compound System of Swing.

3. Materials and methods

Current project started from problem statement followed by the literature review, solid modeling, mathematical modeling, design, fabrication and ended at the experimentation. The purpose is to divert the attention of people towards the alternative energy which is pollution free and low resource mean of electricity production. In this way the energy crisis can be controlled.

4. Results and discussions

Calculations were made to find the number of oscillations that will fully charge a 12 V, 7AH battery. The ideal charging time comes out to be as:

The ideal charging time = $\frac{7AH}{1.5\,A}$ = 4 hours 40 minutes

Where 1.5 A is the average output.
There are 25% losses in a battery. So by considering losses the actual charging time comes out to be 5 hours 50 minutes.
The battery run time is calculated as follows:
The loads we used were:
15W DC fan
9W DC bulb
Using formula;

$$P=VI \quad (1)$$

$$(15+9)W/_{12V} \quad (2)$$

Discharging time= $7AH/_{2A}$=3.5 hours = 3 hours 30 minutes
This means that the fan and the light together can last for about 3 hours and 30 minutes when the battery is fully charged. If both the loads are used separately then they can last longer. Table 01 shows all specification of the current system.

Table 1: Specifications of the System

Generator Output	20 V, 1.5 A
Battery used	7AH, 12 V
Charging Time	4 hours 40 mints
Discharging Time with full load	3 hours 30 mints
DC fan	12 V, 15W
DC Bulb	12 V, 09W

5. Experimentation

Experimentations were performed by getting the voltage output at a specific value of RPM. Table 02 shows obtained results.

Table 2: Power Output vs Voltage Analysis

RPM	Voltage(volts)
120	7.2
160	10.3
220	15.8
250	19.5
344	22

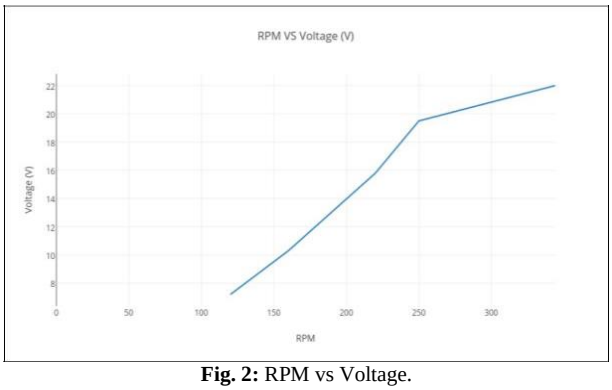

Fig. 2: RPM vs Voltage.

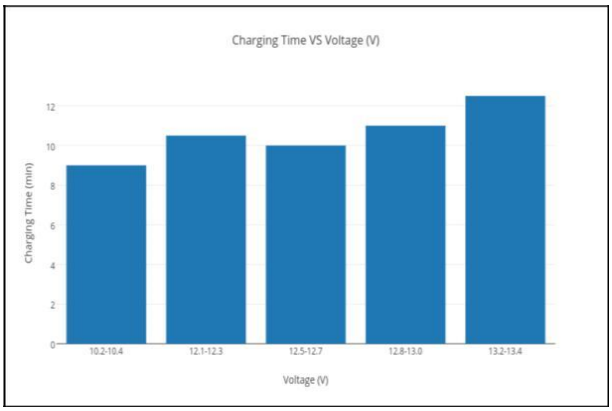

Fig. 3: Charging Time Vs Voltage.

6. Conclusion

Electricity plays a major role in human life. In the world of today we need to discover new ways of generating power. And to save our natural reserves, Electricity generation from swing is one of such ways. We are successful to demonstrate the electricity can be generated through the idea we put forward. Current swing is able to generate enough electricity to power a 15 W DC fan and a 9 W DC bulb. We attach 12 V, 7AH battery with a charging circuit, which stores and regulates the pulsating current. The battery is fully charged in 4 hours and 40 minutes. The completely charged battery can power a 15 W DC fan and a 9 W DC bulb for approximately 3 hours and 30 minutes.

7. Advantages and applications

The following advantages can be obtained from the system:

- It is pollution free system.
- DC output can also be achieved.
- Maintenance is easy.
- The system has huge worth at the places like parks, schools and playgrounds where children use swing.
- Electricity can be stored in battery which can later be used in many applications.

The prototype can be installed in parks, schools, picnic points and homes. The electricity produced can be efficiently used to light the places described above.

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