



INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

(Volume2, Issue2)

Electrical Energy Generation By using Pendulum Motion

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Abstract— *There are a lot of availability of mechanical energy in the environment. This mechanical energy can be converted into other form of energy like electrical energy. Here we developed a pendulum motion based power generator that sustains its motion with low maintenance providing voltage output peaks from a reciprocating mechanical structure. The reciprocating effect of our device is enhanced by using gear mechanism that is composed of shaft with a dynamo. We demonstrate lighting up a commercial LED light bulb by harvesting mechanical energy of the pendulum oscillation. This paper is a platform of developing a sustainable, low maintenance system to generate electrical energy.*

Keywords— *pendulum; frame; generator; charge controller circuit; battery.*

I. INTRODUCTION

This Energy is the primary and most universal measure of all kinds of work by human beings and nature. Everything that happens in the world is the expression of flow of energy in one of its forms Energy is an important input in all sectors of a country's economy. The standard of living is directly related to per capita energy consumption. Due to rapid increase in the population and standard of living, we are faced with energy crisis. Conventional sources of energy are increasingly depleted. Hence, Non-Conventional Energy Sources have emerged as potential source of energy in India and world at large.

Renewable energy resources and significant opportunities for energy efficiency exist over wide geographical areas, in contrast to other energy sources, which are concentrated in a limited number of countries. Rapid deployment of renewable energy and energy efficiency, and technological diversification of energy sources, would result in significant energy security and economic benefits. It would also reduce environmental pollution such as air pollution caused by burning of fossil fuels and improve public health, reduce premature mortalities due to pollution and save associated health costs.

The selection of electricity production modes and their economic viability varies in accordance with demand and region. The economics vary considerably around the world, resulting in widespread selling prices, e.g. the price in Venezuela is 3 cents per kWh while in Denmark it is 40 cents per kWh. Hydroelectric plants, nuclear power plants, thermal power plants and renewable sources have their own pros and cons, and selection is based upon the local power requirement and the fluctuations in demand. All power grids have varying loads on them but the daily minimum is the base load, supplied by plants which run continuously. In this paper we have proposed the hardware setup of the pendulum system, charge controller circuit and its battery unit.

II. PROPOSED SYSTEM

A. General Block Diagram of proposed system

The Block Diagram of the proposed system given below deals with the overall system design and process flow control.

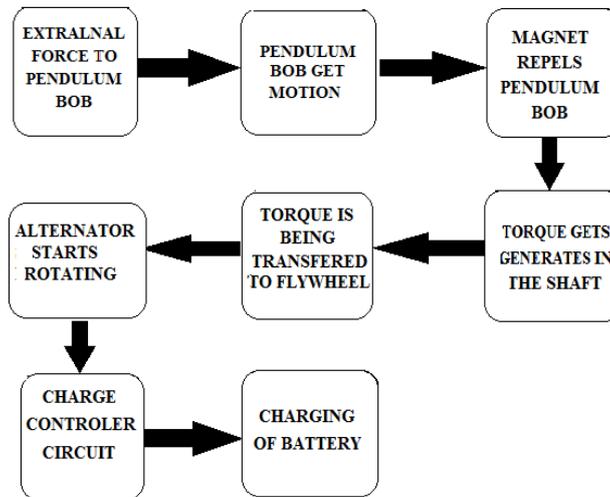


Fig 1: Proposed System Block Diagram

The pendulum model will be generating power from the real time dynamic movements. Once when the pendulum is disturbed from its equilibrium position it swings to and fro. The anti-pendulum power generator is the machine which converts the motion of pendulum i.e. mechanical energy into electrical energy. In this generator the pendulum is attached on a horizontal rod connected at the point at which it moves freely over the surface. The pendulum moves between the fix magnets with similar polarity. Both side of the pendulum are attached with the magnet. When pendulum starts moving the rod connected to the pendulum also starts rotating, then the wooden frame connected to rod also starts rotating along with the rod. The wooden frame is connected to the flywheel with the help of chain. In this way the mechanical energy of pendulum is transferred to Flywheel. Flywheel is connected to the generator. The mechanical energy of flywheel is converted into electrical energy with the help of generator. The electrical energy is stored in the battery with the help of charge controller circuit.

B. Schematic arrangement of Pendulum setup

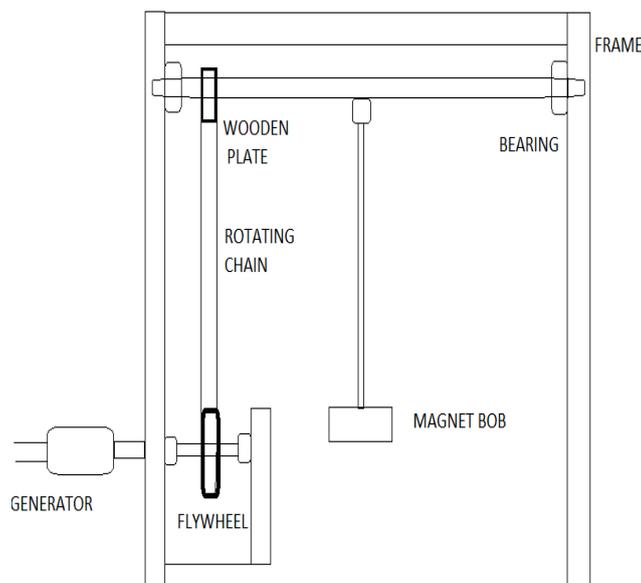


Fig 2: Schematic Arrangement of Pendulum Setup

C. Components of the Pendulum Power Generator are:

i. Neodymium Magnet

Neodymium magnets are a member of the Rare Earth magnet family and are the most powerful permanent magnets in the world. They are also referred to as NdFeB magnets, or NIB, because they are composed mainly of Neodymium (Nd), Iron (Fe) and Boron (B). They are a relatively new invention and have only recently become affordable for everyday use. N35, N38, N42, N38SH...what does it all mean? Neodymium magnets are all graded by the material they are made of. As a very general rule, the higher the grade (the number following the 'N'), the stronger the magnet. The highest grade of neodymium magnet currently available is N52. Any letter following the grade refers to the temperature rating of the magnet. If there are no letters following the grade, then the magnet is standard temperature neodymium. In this setup we are using N35 grade neodymium magnet.



Fig 3: Neodymium Magnet

ii. Pendulum

A simple pendulum consists of a relatively massive object hung by a string from a fixed support. It typically hangs vertically in its equilibrium position. The massive object is affectionately referred to as the *pendulum bob*. When the bob is displaced from equilibrium and then released, it begins its back and forth vibration about its fixed equilibrium position. The motion is regular and repeating, an example of periodic motion. The number of complete swings (from one side to the other and back again) made by a pendulum per second is its frequency, f . The time period of one swing of a pendulum is dependent only upon the length of the pendulum and but also the mass of the bob, or how high it swings. Further, with reference to the above kind of motion, we define amplitude, time-period, and frequency as follows:

Amplitude: - The amplitude of a simple pendulum is defined as the maximum angular deviation from the mean position of the bob.

Oscillations: - If the pendulum moves from one extreme position to the other and back to the first it is said to have performed one oscillation.

Time Period: - The time period of the simple pendulum is defined as the time required by the pendulum to complete one oscillation.

Frequency: - The frequency of the simple pendulum is defined as the number of oscillations performed per unit time.

In the setup we are using two Neodymium magnets on either side of bob for continuous motion.

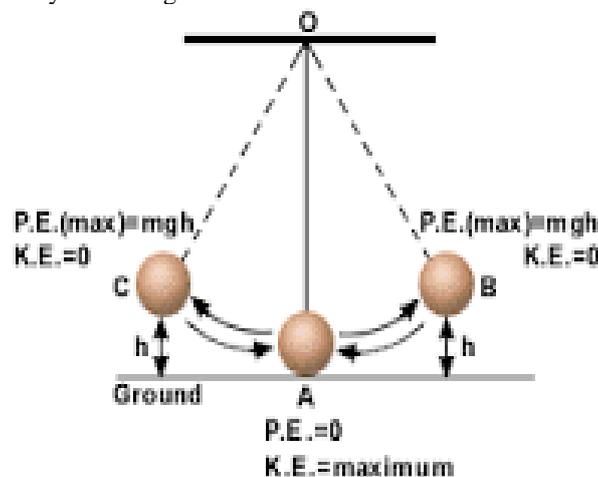


Fig 4: Pendulum Motion

The period of swing of a simple gravity pendulum depends on its length, the local strength, and to a small extent on the maximum angle that the pendulum swings away from vertical, θ_0 , called the amplitude. It is independent of

the mass of the bob. If the amplitude is limited to small swings the period T of a simple pendulum, the time taken for a complete cycle, is

$$T = 2\pi \sqrt{\frac{L}{g}}$$

Where L is the length of the pendulum and g is the local acceleration of gravity.

iii. Supporting Frame

It is a non-magnetic material frame of 3 feet height and 4 feet length to support the pendulum in motion. It is well fixed with nut and bolts to the base which is made up of wooden board. At the centre of the supporting frame, pendulum is attached in such a way that, it will allow the continuous motion of the pendulum without any interference. The bearings are provided on both the side for the smooth motion. Magnets are fixed on both side of the frame to ensure the force of repulsion between the magnets on frame and magnets on the bob.

iv. Low RPM Generator

Low rpm generator produce power at low revolution per minute. Low rpm generators once employed provides years of usage. These generators not only provides higher efficiency but also have low cost. Low rpm generator are used because it gives a highly reliable power output as they work at less speed which leads to less wear and tear of the various part of generators. In our setup we are using low rpm generator to convert mechanical energy into electrical energy.



Fig 5: Low RPM Generator

v. Charger Controller Circuit

It is a pendulum battery charger circuit that is used to charge Lead Acid or Ni-Cd batteries using the energy generated by pendulum. The circuit harvests pendulum energy to charge a 6 volt 4.5 Ah rechargeable battery for various applications. The charger has voltage and current regulation and over voltage cut-off facilities. The circuit uses a variable voltage regulator IC LM 317. Charging current passes through D1 to the voltage regulator IC LM 317. By adjusting its Adjust pin, output voltage and current can be regulated. VR is placed between the adjust pin and ground to provide an output voltage of 9 volts to the battery. Resistor R3 Restrict the charging current and diode D2 prevents discharge of current from the battery. Transistor T1 and Zener diode ZD act as a cut-off switch when the battery is full. Normally T1 is off and battery gets charging current. When the terminal voltage of the battery rises above 6.8 volts, Zener conducts and provides base current to T1. It then turns on grounding the output of LM317 to stop charging.

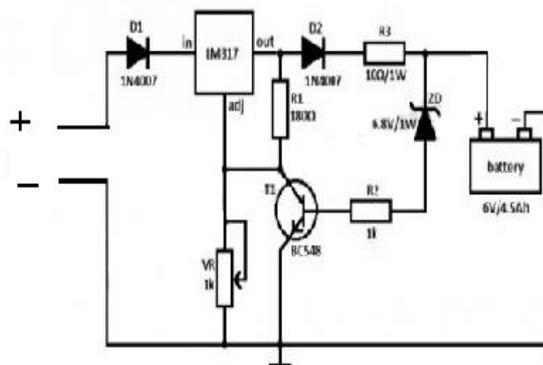


Fig 6: Charger Controller Circuit

III. ADVANTAGES OF PENDULUM GENERATOR

1. It required small area for installation of this setup.
2. It requires less maintenance work.
3. It is portable and can be used in remote areas.
4. It is Environment friendly.
5. It does not require no running cost because it does not required any fuel.
6. Continuous, Sustainable and Reliable Energy Source

IV. CONCLUSIONS

Energy harvesting is, in itself, an energy resource. At the end of a research we have designed a power generator with a pendulum that employs the concept of reciprocating system. The ambient vibration can be used in an effective way by converting them to electrical energy. It proposes energy conversion system in terms of generating electricity. The technique of implementing the pendulum power generator is to reduce global warming. The compact model not only provides the accurate result but also gave the computational speed-ups of the generation. In future, maximize version of our setup can be installed to produce power.

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