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Pendulum Powered Electricity Generation

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Abstract : An experiment has been carried out in order to convert oscillatory motion of simple pendulum into rotatory motion which is further transformed into electrical energy. For performing the experiment, a 52.07 cm length vertical pendulum of aluminium attached with a bob of 700 gm weight is connected to a threaded screw axle of 6 mm outer diameter. The wheel is connected to threaded screw axle with the help of ball bearings of 6 mm diameter. The gear ratio of pinion and wheel is 1:6. The pinion is connected to a 6V step up gear generator which converts rotatory motion into electricity. The step up generator produces electricity which goes to MPPT (Maximum power point tracking) circuit where alternating current is converted into direct current using a rectifier. The generated direct current charges the two batteries of 4V each connected in series which act as a source of electricity. This innovation can be used to provide electricity in rural areas where there is a shortage of electricity. It can also be used to reduce the power consumption done by electrical appliances. After the completion of experiment we came to a conclusion that this working model is the simplest and very low cost source of electricity generation which will help in solving the electricity problems all over the country especially in slum areas.

Keywords: pendulum, threaded screw axle, MPPT, step-up generator, rectifier, oscillatory

1. INTRODUCTION

A pendulum can swing freely because of the weight adjoined from a hinge. The bob of the pendulum is at rest in equilibrium position and when an initial displacement is given it moves sideways. Due to gravity a restoring force acts on it which brings back the bob to its equilibrium position.

Patent US4352023 [1], explains a method of producing power from the motion of waves on a body of water. In this method a buoyant body is taken into consideration because it floats on water and due to motion of the waves of water it rolls and pitches. The oscillatory motion of the buoyant body is converted to rotatory motion by a gyro-wave energy transducer. There are two frames in the transducer i.e. first and second frame. The first frame is attached to second

frame pivotally and the second frame is attached to the buoyant body pivotally. With the first frame a device called gyroscope is attached which performs the function of rotating with respect to an axis perpendicular to the axis of rotation of both the frames. The rotational velocity of the gyroscope is controlled by a motor which is attached to the gyroscope. Electrical energy is generated by the relative movement of both the frames which is taken into consideration by an electrical generator. The electrical energy is stored in the battery which is attached to the buoyant body. The function of the control circuit is to provide maximum power by controlling the time rate of change of current generated by the generator. Patent US4748338 [2], explains an investigation in which the reversal of erosion of beach sand and an electric power generation system is extracted from an ocean wave energy. Before the waves break their energy is used for the deposition of sand which reduces the disorder. The driving shaft of an electric generator is a robust, weighted pendulum. The source of swing of the pendulum is the ripples of the ocean waves. It swings by means of coils of the cable and step up pulleys. The electricity is generated from an electric generator due to force applied by the rotating pendulum. Patent US7239038 [3], explains a mechanism in which a generator consists of a couple of arcuate swing arms which have their ends passed by a base pivotally so that both the arms are perpendicular to each other. The relative movement between the body which can be a pendulum mass and the base helps in driving an electric generator that leads to the generation of electricity.

2. EXPERIMENTAL SETUP

The setup consists of:

- Vertical Pendulum- It is made up of aluminum rod whose length is 52.07 cm and width 1.90 cm. A bob of 700 gm is attached to it.
- Threaded screw axle- It has an outer diameter of 6 mm and is connected to ball bearings of 6 mm.
- Wheel and pinion- Both are connected with the help of a teflon rubber belt and they have a gear ratio of 1:6.

- d) Step up gear generator- It is a device which converts rotatory motion to electrical energy. It operates at 6V.



Fig. 1. Vertical Pendulum.

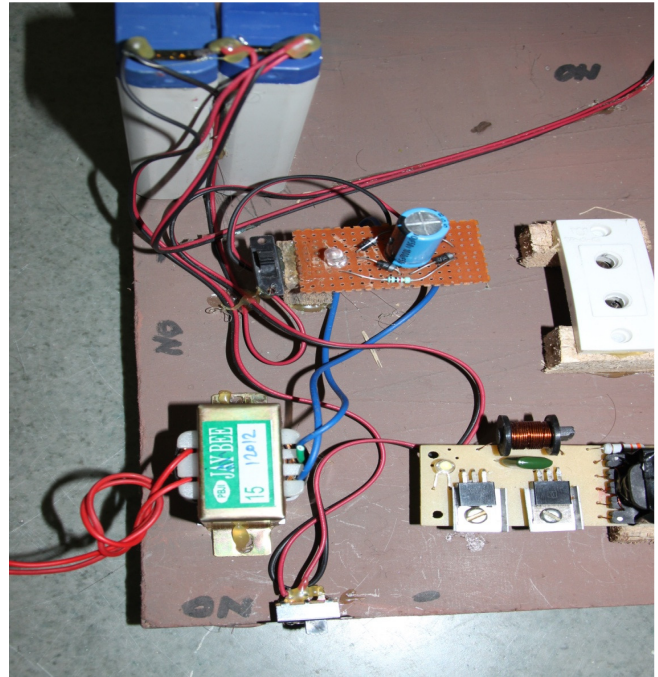


Fig. 3. MPPT Circuit.

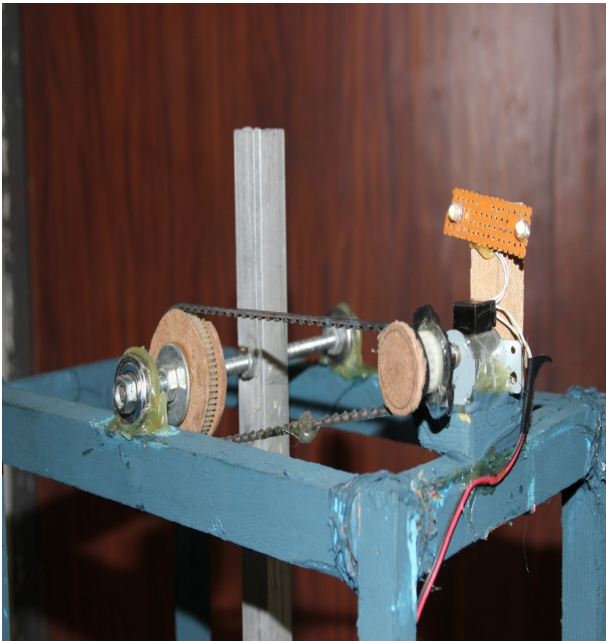


Fig. 2. Step up Generator.

- e) MPPT(Maximum power point tracking) circuit- It consists of 2 transistor type MOSFET CTC 100, ceramic capacitor, heat sink induction coil, step up transformer(0.3 to 2.6 A), 3 IN4007 p-n junction diodes. Sliding switch, two 4V lead acid batteries, full wave bridge rectifier circuit, 1000 μ F 50 V electrolyte capacitor, step down transformer, four 0.5W LED bulbs.



Fig. 4. LED Lamp.

2.1 WORKING

In the working model the oscillatory motion of the pendulum is converted into rotatory motion with the help of spur gear pulleys. Further, the rotatory motion is transformed into electrical energy with the help of step up gear generator. The generation of electricity is signified by 2 LED lights. The step up generator generates alternating

current which goes to MPPT (Maximum power point tracking) circuit. This circuit consists of transistors which perform the function of amplifying the signals and the heat losses are reduced as it passes through the heat sink induction coil. Step up transformer performs the function of amplifying the current from 0.3-2.6A. The alternating current is converted to direct current by the rectifier. The direct current produced is used to charge the battery. From the battery direct current goes to DC LED lamp through sliding switch. When female socket is on, due to the reverse biased process between battery and MPPT circuit the current does not go to the battery from step up generator. In reverse biased process there is flow of direct current from battery to LED lights and then to MPPT circuit. Here, the MPPT circuit acts as an inverter which performs the function of converting direct current to alternating current. The generated alternating current goes to female socket.

If an external AC source is used to charge the battery then the current flows through Step down transformer which reduces the magnitude of current. Further, this alternating current is converted to direct current by passing it through full wave bridge rectifier circuit. Electrolyte capacitor performs the function of providing constant power to battery. In this way, battery gets charged and the DC LED lamp is lightened up.

3. RESULTS

In this working model one form of motion is converted into another form. The input source is pendulum which exhibits oscillatory motion that is converted to rotatory motion with the help of spur gear pulleys and finally rotatory motion is converted into electricity with the help of step up gear generator. Through generated electrical energy a 2W DC LED lamp is lightened and a female socket is also used for different applications.

4. CONCLUSIONS

Nowadays, demand of electricity in India is more than the supply as source of raw materials like coal etc. are disappearing quickly. To solve this issue an investigation on working model of pendulum has been performed related to generation of electricity. There are various applications like it can be used in rural areas of India where electricity is not available in suitable amount, in cyclone prone areas, in urban areas by using them in place of tube-lights, bulbs which reduces the amount of power consumed. In future, best results can be obtained from this model by varying the dimensions and specifications.

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