

Changing Perspective: Gravity Light

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Abstract: We think we live in modern world but there are still areas which have limited or no supply of electricity. Most of this area is located in mountains where we cannot provide electricity generated from tidal, hydroelectric, thermal energy by grid connectivity as they are situated in very remote places. They still depend on kerosene lamp which we consider as obsolete. So how to provide electricity in such places? You might think of solar or wind energy. But the problem with solar energy is it varies from places to places which are same with wind energy. So we've to think a better alternative to get rid of this question and which is also viable.

Here Gravity comes into picture. Our idea is to use the concept of bicycle dynamo electricity generation. The only difference is we're going to use gravitational pull instead of pedal work. The overall setup of gravity light can be operated indoor just by hanging some weight to gear train which in turn rotates generator which generates light. The gravity light requires only initial investment and no running cost. The cost of gravity light is approximately equal to the cost of kerosene required to light lamp for 3-4 months after this span it saves money.

Keywords: DC Motor, Electricity Generation, Gear Train, Gravitational Energy, Sustainable.

I. Introduction

Electricity is one of the basic needs without which development is not possible. Numbers indicate an estimated 1.2 billion people – 17% of the global population – did not have access to electricity in 2013, 84 million fewer than in the previous year. Many more suffer from supply that is of poor quality. More than 95% of those living without electricity are in countries in sub-Saharan Africa and developing Asia, and they are predominantly in rural areas (around 80% of the world total)[1].

In such areas people still use kerosene lamp, biomass which is expensive and pollutes atmosphere. Kerosene lamps are hazardous to health and environment and constantly require replenishment. Fumes which are raised from the burning of biomass fuels can cause cataracts and eye infections as well as emitting smoke that is the equivalent to smoking two packets of cigarettes every day [2]. Also it is estimated that yearly almost 2.5-3 million people suffers severe burn due to kerosene. So to provide lighting in such areas is a key challenge. The problem with other renewable energy sources like solar, wind energy is, they vary from location to location and they are based on weather conditions.

So we thought of new alternative. Here gravity comes into play. The proposed model of gravity light doesn't require any other form energy except gravity, which is available everywhere on earth. Unlike solar and wind power gravity light remains operational in any climatic condition and all day.

II. Literature Survey

Sir Isaac Newton discovered gravity (when an apple falls on his head) nearly 400 years ago and he put forth law of gravitation after that. Russian Inventor Mikhail Dmitriev to know about his gravity motor. He has apparently devised a mechanism whereby static gravitational pull can be harness to generate useful energy. His design is based on the principle of having weights attached to a wheel and arranging for those weights to be offset outwards when falling and offset inwards when rising. Because of the different lever arms involved, that gives a force imbalance which causes the wheel to rotate continuously and if the weights are of a considerable size, then the rotation is powerful and can be used to generate electrical energy.[3]

A U.S graduate student Clay Moulton developed invented floor lamp name 'Gravia'. His design consists of 4 feet acrylic column. The entire column glows when activated by electricity generated by the slow, silent fall of a mass that spins a rotor. The light output of 600-800 lumens lasts about four hours. To "turn on" the lamp, the user moves weights from the bottom to the top of the lamp and into a mass sled near the top. The weight begins its gentle glide down and, within a few seconds, the LEDs are illuminated. [4]

III. Methodology

3.1 The Main Components in setup are:

1. Bicycle Wheel
2. Bicycle Dynamo (As D.C Generator)
3. Gear Train of Bicycle
4. Chain
5. Weights
6. LED light

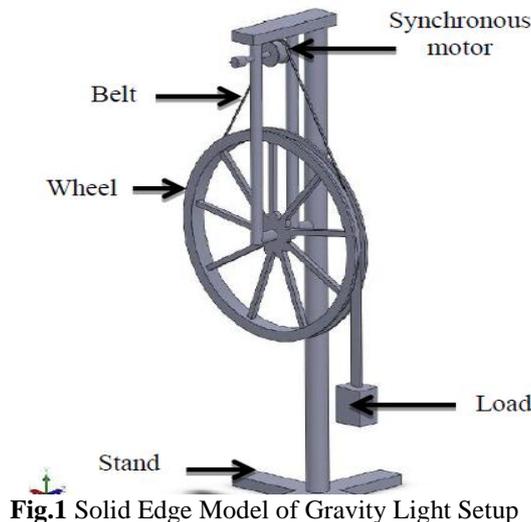


Fig.1 Solid Edge Model of Gravity Light Setup

3.2 Procedure:

The whole assembly is setup on metal frame as shown in model above. The bicycle wheel is coupled with generator shaft by means of belt drive. The gear train is placed on central shaft of bicycle wheel. Bicycle chain is mounted on gear train. On which at one end main weight is attached which is responsible for electricity generation and on other end of chain counter weight is attached so that main weight doesn't fall too quickly?

As main weight started to fall below, counter weight rises to top which rotates gear sprocket which in turn rotates the bicycle wheel. The motion of bicycle wheel is then transmitted to shaft of bicycle dynamo (D.C generator) which when rotates with sufficient revolutions per minute, generates electricity. This electricity is used to light LED.

Gravity light is a light (one or more LEDs) that is powered for a useful amount of time by a slowly falling object, or mass. As shown in the diagram below, the whole idea is to have the masses fall as slowly as possible, taking as long as possible, while still causing the generator to turn fast enough to power the LED light. With the system below, even though the small sprocket is turning slowly, the outer edge of the large pulley/wheel that it's attached to is turning fast which turns the generator shaft which in turn produces electricity which is used to generate electricity. The generator we are going to use bicycle dynamo of 12V,6W capacity.

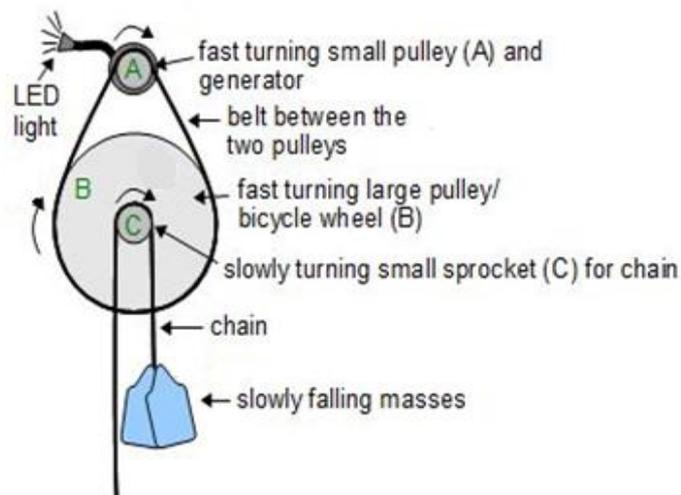


Fig.2 Schematic representation of Gravity Light Setup

IV. Observations

Initially the runtime was only 12 minutes with the weight required to generate light 8kgs. After analysing the problem and we found out that as weight goes down beyond 6-7 feet their motion accelerates. So we placed counterweight to eliminate this problem and we got runtime of 16 minutes. To maximize runtime, it is necessary to place the chain on smaller diameter sprocket of gear train.

The runtime obtained after placing chain on different gears is shown in table below. As the diameter of the gear decreases (1st to 4th) the mass required to generate desired light increases.

Sr. No.	Gear Train (No of gear on which chain is mounted)	Mass (Kg)	ApproxRuntime (Minutes)
1	1 st	8	16
2	2 nd	9.5	22
3	3 rd	11.7	27
4	4 th	15.3	36

Table 1. Variation in runtime with respect to gear and mass.

V. Calculations

5.1 Power and Efficiency Calculations:

Mass required in kgs: 15.3 kgs

Distance it falls: 12 ft(3.65 m)

Time it falls: 36 minutes

$15.3 \times 9.81 = 150.09$ N (weight or downward force)

150.09 N x 3.65 m distance = 547.82 J (joules)

547.82 J / (36 minutes x 60 seconds/minute) = 0.25 W (watts)

The measured voltage and current while the lights were lit.

Current: 15 mA (0.015 amps)

Voltage: 12 volts

Power = current x voltage = 0.015 amps x 12 volts = 0.18 watts

Comparing the two, (0.18 watts / 0.25 watts) x 100 = 72% efficiency

VI. Conclusion

Generation of gravity power can be increased by applying much heavier load at the end of bicycle wheel. Though heavy load increases the voltage and current of synchronous motor but it decreases the lighting time of LED. Applying heavy load, it may cause bending to the pipe stand. So a suitable mass must be used to fall it as much long time as possible.

Renewable energies are currently looked at as the sources which will meet the future energy requirements. Solar, Wind, Tidal, Geothermal are some popular examples of renewable energy sources. Yet these sources have their own unique geographical as well as other limitations and are not available throughout. But gravity is available across our entire planet. Thus we can use something like electricity from gravity on a large scale to generate electricity any time at any place.

Gravity light will be able to replace Kerosene Lamp and other obsolete lighting mediums. Also it will provide renewable, sustainable and cheap alternative to conventional lights. The impact will be beneficial for the social, health and economic situations of end users. With gravity light installed in each one of these homes eliminates the hazards of kerosene lamp, biomass which in turn improves environment, health and also reduce greenhouse emissions.

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