

Fabrication of Electricity Generation System Utilizing Gravitational Force

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Abstract— Declining in the conventional energy resources is forcing engineers and scientists to develop new method of harnessing the energy. Gravity being abundant and sameevery time with same intensity can be used to generate electricity by using the mass raised to height above the Earth's surface. With the help of this potential energy stored in a falling mass electrical energy is generated which is supplied to a dynamo used to power LED bulbs. In order to achieve this a mount was designed which carries an arrangement of gears in a cage out of which a shaft is hanged, weight is attached on the shaft which fall down due to a gravity. As the weight falls down that gives approx. 12 rpm to the first shaft, using compound gear train this rpm is increased to 720 rpm. At the end of the fourth shaft a dynamo is attached that changes 720 rpm into electricity that can easily burn a LED light. This light will be enough to illuminate a room. The project generates electricity with minimal or no maintenance cost and it can be used in remote areas where providing electricity is a formidable task.

INTRODUCTION

In the current scenario, the world faces the grave danger of running out of natural resources. Human beings are using petroleum, coal, kerosene, natural gas, and many other petroleum-derived products extensively. Such non-sustainable usage of natural resources can lead to their ultimate depletion. These resources also cause lots of pollution. Their extensive use leads to problems like Greenhouse Effect, Global Warming, etc. which can prove to be catastrophic [1].

Many people in the world use lamps burning through kerosene to get light in the dark at their homes. They also use biomass like wood and manure to get heat by using open fires. Due to the air pollution caused by this, millions of people getting illness and getting die prematurely. Most of the people use such ways of producing heat or light are economically week and lives in a developing country. If such technology is used in a poorly ventilated rooms then smoke produced there can be 100 times more harmful for lungs than an acceptable level of fine particles. In all, 7-10% of the kerosene ends up in the atmosphere as black carbon. The main causes of death in the underdeveloped countries is 12% pneumonia, 34% stroke, 26% heart disease.

Therefore, the world needs more sustainable resources and we must switch to alternate resources that do not cause pollution of any kind or affect the environment in a negative way. Electricity is not reaching to nearly 20% of the people in the world. Such people are bound to use kerosene lamps for their daily needs.[2] Therefore, to eliminate these kerosene lamps, we came up with an idea to generate electricity by using manual power or by utilizing gravity. This device can generate light by pure mechanical power transmission and does not use any fuel. This device uses a simple transmission mechanism to convert mechanical energy to Electrical/Light energy. The device is installed with a weight or is driven manually using a handle. This input energy powers a gear train that rotates slowly at the input with high torque (force). Thus, the final output is in the form of kinetic energy from initial energy. The output gear rotates with faster rpm and less torque that in turn provide energy to a Dynamo that rotates at very high rpm. The Dynamo is connected to a LED bulb, which is powered due to the rotational movement.

This process uses very less power and uses absolutely no fuel. Hence, it does not cause any kinds of pollution, which is great for the environment.[3] It cuts the fuel expenses, provides more light for work/study, improves health and living conditions and decreases the pollution. Therefore, this device can be can be invaluable for the betterment of the environment in the long run.

OBJECTIVES AND SCOPE OF THE STUDY

The immense dependency on natural resources like petroleum, coal, kerosene, etc. is not sustainable in the long run. The usage of these fuels also pollutes the environment and causes greenhouse effect and global warming. Millions of people in under-developed and developing countries do not have the facilities to use electricity for their basic needs. Reduce the dependency on natural resources, a device, which generates electricity using gravity-powered mechanism, is needed. It is also cost efficient and sustainable. If this idea is rightly implemented, it can save millions of dollars of costs incurred due to the purchase of fuels. Finally, replace the kerosene lamps with the gravity-powered device which can provide more light intensity with less cost and more reliability.

The main purpose of our project is to provide an alternative to kerosene lamps and other fuel-driven lamps. It aims at reducing the pollution caused due to fuel-driven lamps and also reduces the costs incurred (fuel costs). It also improves the living standards and the

conditions of the people who don't have access to electricity. Since it uses gravity as a powering medium, which is a renewable source of energy, there is no harm caused to the environment. Therefore, it is in the right sense that the kerosene/fuel-driven lamps be replaced with more sustainable devices that produce electricity by using gravity as the driving medium. It can also be used in mining areas. Miners who work underground can make good use of this device to help them light up the underground tunnels. It can act as a replacement to the conventional flashlight.

Approximately 1/3rd of the population is off-grid, having no access to electricity. This situation cannot be changed completely at least in the coming few decade [3]. The main objective of this project/study, as stated, is to replace all the kerosene lamps and other fuel-driven lamps. Even the other renewable sources of energy, like Solar, Wind, Tidal, Geothermal Energy, etc. have their limitations even though they are sustainable.[4] With gravity as a powering medium, which is ever available, this project is completely reliable in producing light and uses absolutely no fuel or electricity. It is therefore, completely reliable and safe. The project also aims to reduce the pollution caused due to the usage of fuel-driven lamps. Eradicating these lamps would help in conserving the natural resources and protecting the environment. It is also beneficial in improving the life standards of the people living in poverty. The maintenance cost is too low, thus after the initial investment in this kind of mechanism, it will allow the people to save money for other purposes. It caters to the basic lighting needs of the poor. It is completely clean and green.

FABRICATION AND DESIGN

After theoretically designing and simulating the model, actual fabrication of the model is done. The difference between them is quite minimal. Gear trains generally have high efficiency of over 90%. After practically testing it out, it has been proved true.

The model is easy to use and provides a light, which is brighter than that produced by kerosene lamps. The dropping of weight is easier and more efficient if timing belts are used instead of normal ropes to support the weight.

Researching and using different materials further improves the working of this model. For example, using Nylon or Polyurethane instead of Mild Steel could decrease the overall weight of the model, which is favourable and beneficial. Decreasing the overall weight of the

model also helps in saving material from wastage and also saves money (reduced cost of materials). Lightweight materials that are of low cost are the ideal materials that can be used to manufacture these models.

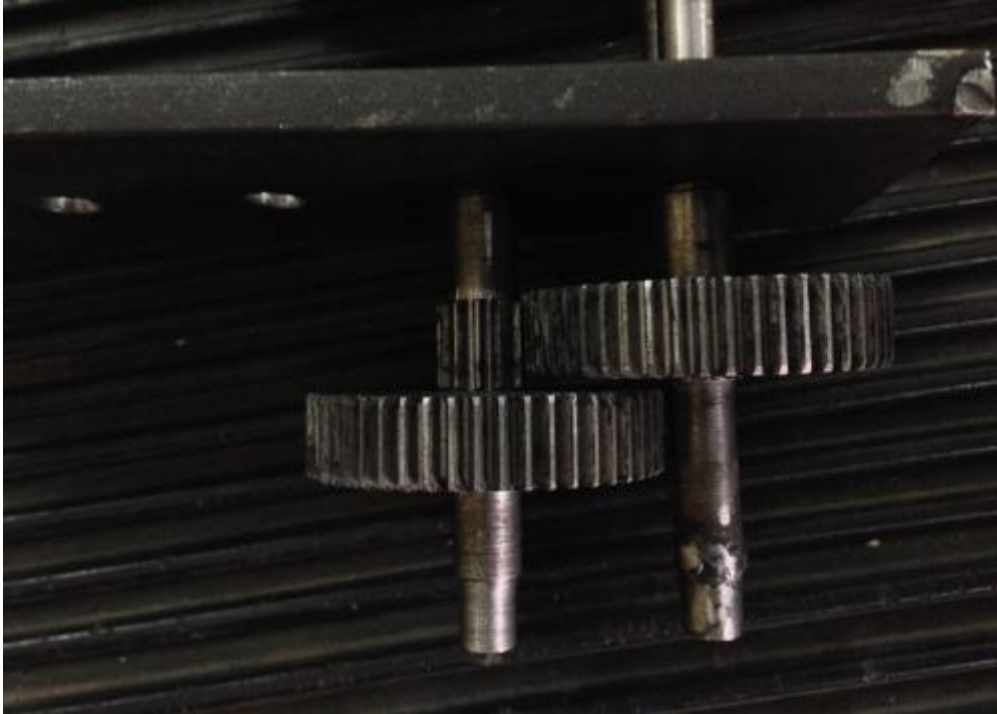


Figure 1. Arrangement of gears

G52 TEETH GEAR

Pressure Angle = 20°

Pitch Diameter (d) = 54 mm

Module (m) = $d/T = 54/52 = 1.03846154 \text{ mm}$

Circular Pitch (pc) = $d/T \times \pi = m \times \pi = 3.2607 \text{ mm}$

Circumference = $2\pi r = 2 \times \pi \times 27 = 169.56 \text{ mm}$

13 TEETH GEAR

Pressure Angle = 20°

Pitch Diameter (d) = 13.5 mm

Module (m) = $d/T = 13.5/13 = 1.03846154 \text{ mm}$

Circular Pitch (pc) = $d/T \times \pi = m \times \pi = 3.2607 \text{ mm}$

Circumference = $2\pi r = 2 \times \pi \times 6.75 = 42.39 \text{ mm}$

The Gear Ratio of the mechanism is 4:1.

Suppose, the input shaft is provided with RPM of 12, the speed of the corresponding shafts will be:

- 1st Shaft – 12 RPM
- 2nd Shaft – 48 RPM
- 3rd Shaft – 192 RPM
- 4th Shaft – 768 RPM

Therefore, by providing a small input speed of 12 RPM to the input shaft, we can obtain 768 RPM on the output shaft. The speed of rotation of the output shaft depends on the input speed provided to the input shaft. To glow the LED, we need an approximate speed of 775 RPM, although a speed in the range 750 – 800 is allowable. This has been measured by using trail & error method.

The center distance between corresponding shafts is 33.75 mm.

The total length of the frame is approximately 180 mm.

The total length of the shaft is 75 mm.

$$T1 = T3 = T5 = 52$$

$$T2 = T4 = T6 = 13$$

The Speed Ratio of the Compound Gear Train is 0.015625.

The movement can be given to the input shaft by using a 10-15 kg weight or can be manually provided using the handle attached to the input shaft.

RESULT

The LED is lighted when an output speed of 775 RPM is provided to the output shaft. The output shaft is connected to a DC Generator or Dynamo. The output shaft rotates the dynamo, which in turn is connected to an LED. The rotational motion of the dynamo generates electricity that is sufficient for the LED to glow.

The input speed provided is 10-12 RPM. This drives the gear train and provides the required 775 RPM at the output. However, it has been observed that providing speed less than 750 RPM or more than 900 RPM doesn't make the LED glow. It only works in the range 750 – 850 RPM. For this optimum range to be obtained, we need to provide an input speed of 12-14 RPM, not less and not more. Therefore, proper care must be taken to ensure that rule is obeyed.

However, if a different and more powerful LED is used, then the speed and the speed range, both may differ. Different input speeds need to be provided for different LEDs.



Figure 2. Top view and Side view of the gear arrangement

CONCLUSION AND SUMMARY

As previously stated, the gravity-powered light is completely reliable and doesn't need any fuel to power it. The gravity-power mechanism has a lot of advantages over the conventional fuel lamps. Here's a list of advantages the gravity-powered light has over the kerosene lamp:

- Economical
- Sustainable
- No Harmful Emissions (0% Pollution)
- Stable Energy Output
- Not susceptible to weather patterns

- Greater Light Intensity
- No Operating Costs
- Doesn't Require Batteries or Fuel

Using gravity-powered light instead of kerosene/fuel-powered lights can save a lot of money. Each piece/model costs only 500-700 rupees and no costs will be incurred after the initial purchase of the product. Therefore, it is very cost efficient.

Only a small starting energy is required to implement an energy conversion for a long time, providing a stable output. The other merit of the gravity-powered mechanism is that it can independently generate electricity by using the ever-reliable source of energy – Gravity.

FUTURE SCOPE

Alternative mechanisms can be used to improve the design and working of the current model. A pulley system can be incorporated instead of a gear train system for smoother functioning of the system. A more robust model can be designed so that it can be used in harsher environments.

The device can be fitted with a USB port to charge a mobile phone. This further increases the utility of the device. Many other ideas can be incorporated into the design to improve its utility.

Hence, there is a lot of scope for improvement of the design of the model. A much more compact design can be designed and manufactured if this project is further researched and funded.

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