

DESIGN, ANALYSIS AND WORKING OF A LIGHT GENERATING SYSTEM USING GRAVITY

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Abstract - It is estimated that the global energy requirement presently is of the order of 15 terawatts and this value expected to increase enormously in the future with the increase in population in developing countries and with the higher standards of living that these countries strive for, and traditional methods of electricity and energy generation such as fossil fuels are merely a tiny blip compared to this number. Therefore, it is of vital importance that we require generation of energy using other non-polluting methods. We can think of a number of ways to generate clean and renewable energy to light up homes such as solar and wind energy but the costs associated with manufacturing and/or setting these systems up are way too high. To solve this problem, we have designed a system that can generate light using gravity. This is much cheaper than the other alternatives, with no operation costs and is a clean and non-polluting form of energy.

Keywords - Electricity Generation, Gravity, Leds, DC Generator

I. INTRODUCTION

Like basic requirements such as food, shelter and well-being, light and electricity is also one type of basic need for people, without which development will not be possible. A significant population of people do not have lights or electricity in their homes or have a very erratic and rare supply. These people usually burn biomass in their homes as it is easily available in rural areas, wherein the majority of this population resides and burning biomass produces heat and also produces light from the combustion. However, the fumes associated from burning biomass has adverse effects on the health of these people. Therefore, it is of vital importance to replace these traditional methods with new technologies which are cheap, scalable and do not have any negative effects on the health of humans and on the environment. This need was what led us to think of this alternative form of producing electricity. The main concept is that of cycle dynamo-electricity generation. However, we used gravitational-pull mechanism instead of pedal work. This is done by hanging a fixed weight on the gear train, which in turn rotates generator which generates light and/or electricity. The light can be operated indoor very easily. Another big advantage apart from the fact that it is compact is that, unlike wind and solar energy, whose efficiency depend on various factors such as wind speed, temperature and humidity, this technology is not dependent on daily and annual weather and climate fluctuations and this can operate with constant efficiency irrespective of time of day or time of year.

II. PRINCIPLE

Light is produced by the means of an LED bulb that is fixed on an adjustable lamp, which can either be hung from a ceiling to light up homes more efficiently or can also be hooked onto a wall.

Altogether, the device comprises mainly of a pulley mechanism and a weight (in the form of a ballast bag) that is hung from the lamp. The principle on which this device is designed is similar to that of the clocks which have pendulums. The weights that these clocks have are analogous to the weights in the device. The ballast material effectively represents the potential energy that is associated with the device. That is, gravity converts this potential energy with the slow descent of the weight that is suspended. It is the converted potential energy that results in the generation of electricity in the form of light energy from the LED bulb.

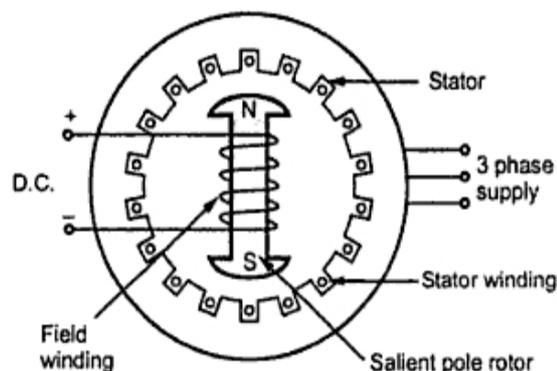


Fig 1. Cross section of Synchronous motor

The time that the device can be continuously operated varies depending on the weight of the ballast. However, from our testing and analysis, it was concluded that the average time is between 31-33 minutes. After this, the ballast will have to be recalibrated. The intensity of this light produced can also vary. It depends on a number of factors such as the type and rating of LED bulb connected and the quality of the synchronous motor that is used. However, the light produced from this device is a type of long-lasting continuous light without any fluctuations. The device consists of a synchronous

motor, which is a dual excited machine. This implies that this motor has 2 electrical inputs that are provided to it. This motor consists of a stator winding that consists of a 3-phase winding is provided with 3 phase supply and rotor is provided with DC supply. Constant flux is produced by the rotor that is carrying the DC supply. The synchronous motor is not self-starting. This means that the motor will require some external means to bring their speed close to synchronous speed to before they are synchronized. This is done by initially feeding the rotor some mechanical input, which will rotate the motor in the same direction and with a speed that is very close to synchronous speed. After sometime, magnetic locking occurs and the synchronous motor rotates in synchronism with the frequency. This means that the speed of operation of is in synchronism with the supply frequency and hence, for constant supply frequency, the motor will behave as constant speed motor irrespective of load conditions.



Fig 2. Front and back side of Synchronous motor

This motor has the unique characteristics of operating under any electrical power factor. In addition to the synchronous motor, a wheel, which is similar in size and dimensions to a bicycle wheel, is required. This has a further advantage in the cost reduction as, old bicycle wheels can be recycled for this device, making this device even cheaper. Whether the wheels are old or new, wheels usually have a rim that is made of metal or carbon, which was originally used to keep the rubber tire in place, but for this device will be effectively used to hold the belt. LEDs are the form of electrical output that we have used for this device, but the output can be in many forms, from a small sound generating electronic instrument to even a battery, wherein electricity can be stored and used later, depending on the requirement. There is also an effective gear system utilized in the device. The larger gears are associated with the belt speeds, movement and the suspension motions. The smaller

gears are coupled with the synchronous motor which provides the input to an electrical circuit. This coupling circuit consists of a rectifier, capacitor and an LED. The larger gears' movement act as an input to the synchronous motor and therectifier circuit converts the alternating current into direct current, resulting in the LED to glow.

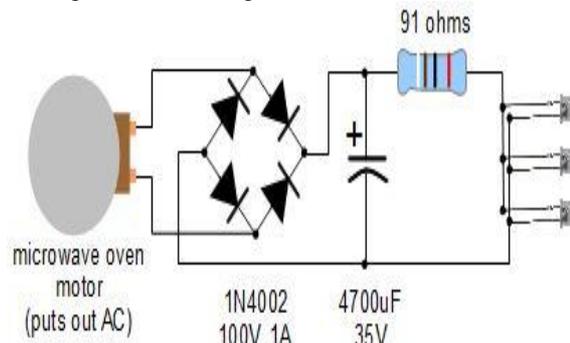


Fig 3. Rectification circuit along with LED(s)

III. DESIGN

The device is designed in such a way that when a weight, which is in the form of the ballast bag is applied to an end of the larger wheel, which is basically the bicycle wheel, due to the natural force of gravity, the load that is connected via a belt will start to move. This movement due to gravity will result in the motion of the larger wheel, causing it to rotate. This rotation of the bicycle wheel, the belt will transmit this rotation onto a smaller pulley, which has the synchronous motor fitted to it.

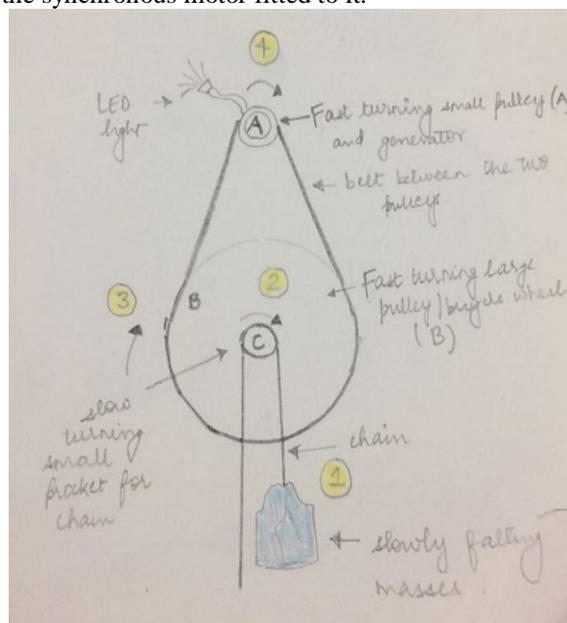


Fig 4. Schematic diagram of Gravity powered Light

The rotation of the synchronous motor is what will ultimately cause the LED to light. However, this synchronous motor rotates with a low circular velocity. It is typically of the order of 3.5-5 rpm. The main aim behind this design is to make sure that

the weight gets displaced towards the ground as slowly as possible which means that we have to ensure that this displacement takes as long as possible. However, for a continuous supply of light from the LED, it is essential that the weights must be moving continuously and should cause the generator to rotate fast enough. Even though the small wheel is turning slowly, the outer edge of the bicycle wheel is turning fast enough to ensure that the LED is continuously emitting light. The motor's functioning is such that, if the shaft of the motor is turned manually, the motor acts like a generator and will produce power. A number of gears are inside this motor. This is what causes the slow turning of the shaft to result in the magnets turning very fast, and producing sufficient power. Therefore, it is beneficial to the wheel system and the motor that this conversion from slow to fast occurs.

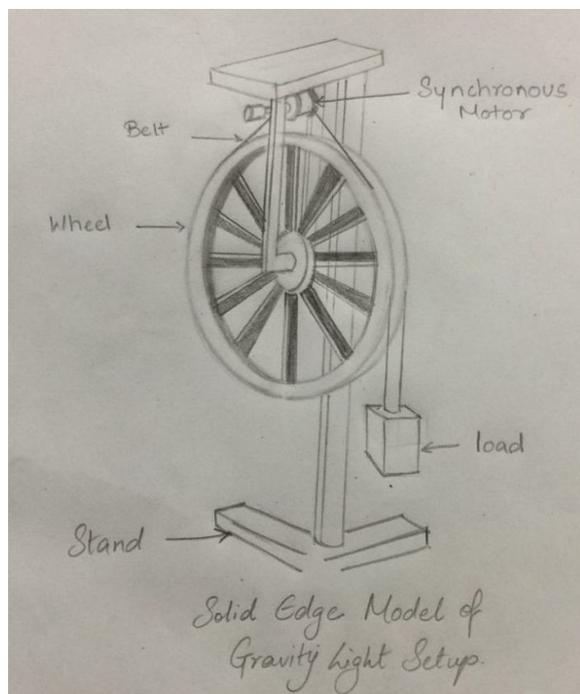


Fig 5. Diagram Representation of the model

IV. TESTING AND RESULTS

In the initial testing stages, the continuous period of time that the LED was glowing was relatively low. It was about 11-13 minutes. However, for successful functioning of the device, a longer runtime was required. After thorough analysis, it was concluded that as the weight goes beyond 4-5 feet, the motion accelerates. This was what led to the significant decreasing of runtime. To overcome this, counterweights were placed to ensure that the acceleration did not decrease the runtime

significantly. To conclude, the device was placed at a height of 1.5 meters and the runtime average between 15-25 minutes. The runtime depends on the mass of the ballast bag. The readings shown above were for a 3-watt LED bulb. The table above shows the variation of the runtime due to the change in weight.

Weight (in Kgs)	Time(in mins)
9	15
10	17
12	19.5
15	23.5
16	25.2

Fig 6. Weight-Time observation table

CONCLUSION

Gravity is the most abundant form of energy that we can harness and use. This has numerous advantages compared to other sources of energy such as solar and wind energy. Its biggest advantage is that it is always constant and has no variabilities. Our main aim was to replace the traditional sources of energy such as biomass which has adverse effects on humans as well as the environment and once this device becomes scalable for production at even lower costs than it is presently, this target can be achieved and this device can be used by millions of people who cannot afford electricity to light up their homes. This will reduce environment impacts, reduce risk of diseases associated with smoke, ash and soot and will preserve biomass, which can be used as manure for agriculture.

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