

FRICTIONLESS POWER GENERATION USING BICYCLE

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ABSTRACT

The intention of this project is to build a straight forward human powered generator from a used bicycle and to use it to power light bulbs, cell phones, laptops, and other small appliances. This project will help to develop engineering skills while learning about a clean way of generating electricity and satisfying our basic requirement. We are going to use the hard drive magnet and inductive coil to generate electricity due to which our mobile phone will be charge and followed by ac to dc converter. This is totally clean way of generating energy. As fuel is not a renewable energy source and the prices are increasing day by day. It will not be affordable by a common man after some period. Here no fuel is required to generate electricity, so everybody can afford this method for power generation also it eliminates the emission of CO₂ which will reduces the pollution. Conventional methods for generating electricity make use of dynamo and wind turbine, but they have disadvantage that they produce friction and reduces speed which require more efforts.

For the project to work we need strong electromagnets so we have used Neodymium magnets and also used coil. The basic idea of this project comes from the functioning of motor, that is how it rotates in the magnetic field and cut's the magnetic line and how flux is introduced into the coil. The motivation behind the project is to generate electricity without having any friction and without using natural resources.

Keywords: Bicycle, renewable power, frictionless generator coils, magnets

1. INTRODUCTION

As the prices of cured oil are increasing day by day and the consumption are also increasing with time. The amounts of natural resources are decreasing. If the rate of consumption remains same, we will have to face power shortage, all means of power generation will be exhausted. Talking about current position everybody is using electrical appliances just like cell phones and user are increasing day by day. They require electrical power for their operation. What else if power is cut? To save the power and natural resources and to fulfill our daily requirement we are going for friction less generation of power using bicycle. As previous methods for generation of power using bicycle was created by using dynamo , wind turbine have various disadvantages just like dynamo provide friction which reduces speed and require more efforts to piddle the bicycle, and wind turbine which cannot generate more power it require more wind energy for generation and the appearance was not so good. All the disadvantages of above methods are over come in this technology which is based on the principle of electromagnetic induction. The energy will be generated by piddling which will rotate the wheel and the assembly place in between the spokes. This energy is stored inside the battery and it can be used to charge mobile phones during driving the

bicycle. This technology does not require any external power supply for charging the equipment's it is a man power generator. It requires only human efforts. This method is very useful during large power cuts. It is a clean way of generating energy; it does not contain any combustion of any kind of fuel. This can fulfill our daily needs for charging our smart phones.



Fig.1.1 Bicycle with Smartphone and charging assembly

2. MOTIVATION

As the requirements for larger scale power generation increased, a new limitation arises in front of us that are limited supply of power requirement of large resources for generating electricity which will definitely increases the price of power.

As in our day to day life we require much power for operating our equipment's. So why to use paid electricity if we have enough renewable resources, technological development? It motivates us to build a power generator for charging our mobile equipment's without breaking your schedule for charging. But there was a problem that we were implementing this project on bicycle which requires muscle power to drive so we can't use simply a motor because it require much effort to drive a bicycle because of friction. So we had design the assembly of motor which will not produce friction and we can get required output.

The basic motivation behind the project was to build a clean energy without combusting fuel, electricity or any other non-renewable fuel. The idea of this project comes from the fact that motor can generate electricity but with friction but if we open the motor and observe it then we will find that there are coils which are called as stator and a rotating magnets which is called as rotor and in between there is an air gap. So why don't we implement a motor on rotating bicycle wheels and stationary sets of coils on bicycle rims. This mechanism can generate electricity and with no friction.

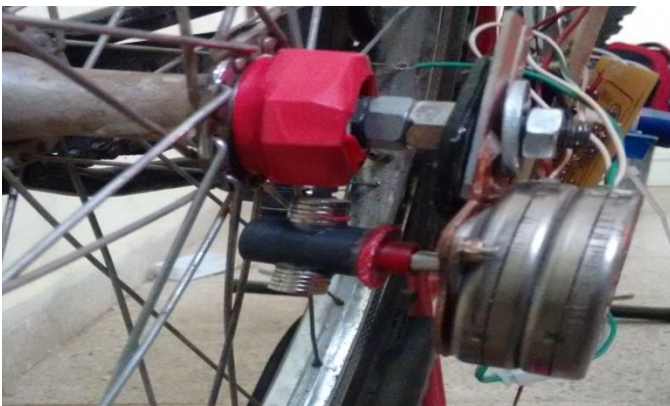


Fig.2.1 Magnet and device assembly

3. BLOCK DIAGRAM OF PROJECT

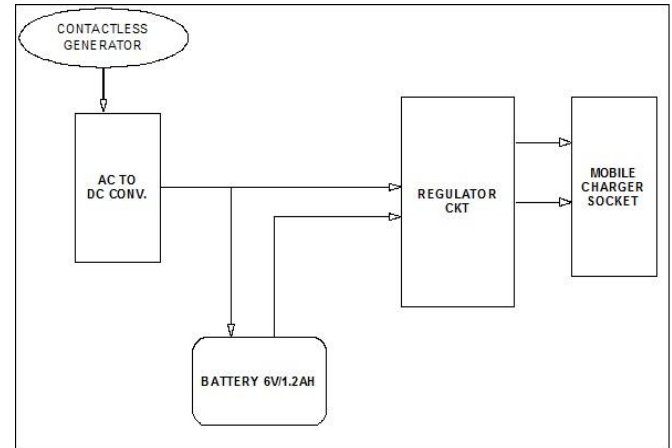


Fig. 3.1 Block diagram of project

In this project we are using a contactless generator assembly which consist of two ring , on one ring we are mounting magnets specifically 12 NEODYMIUM MAGNET and on other ring we are placing 12 coils each with 1500 -2000 turns connected in series with next coil. The output of the assembly is given to AC to DC converter, which convert the generated AC into DC for further use. The DC signal is given to the battery of 8 volt 500mA which store the power.

4. BASIC PRINCIPLE OF OPERATION

4.1 Faraday's Law of Electromagnetic Induction

Faraday's law of electromagnetic induction explains the relationship between electric circuit and magnetic field. This law is the basic working principle of the most of the electrical motors, generators, transformers, inductors etc.

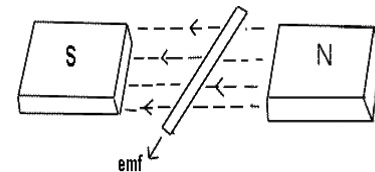


Fig.4.1.1 Faraday's law electromagnetic induction

4.2 Faraday's Second Law:

Faraday's second law of electromagnetic induction states that, the magnitude of induced emf is equal to the rate of change of flux linkages with the coil. The flux linkage is the product of number of turns and the flux associated with the coil.

4.3 Formula of Faraday's Law:

Consider the conductor is moving in magnetic field, then
 flux linkage with the coil at initial position of the conductor =
 $N\Phi_1$ (Wb) (N is speed of the motor and Φ is flux)
 flux linkage with the coil at final position of the conductor =
 $N\Phi_2$ (Wb)
 change in the flux linkage from initial to final = $N(\Phi_1 - \Phi_2)$
 let $\Phi_1 - \Phi_2 = \Phi$
 therefore, change in the flux linkage = $N\Phi$
 and, rate of change in the flux linkage = $N\Phi/t$
 taking the derivative of RHS
 rate of change of flux linkages = $N(d\Phi/dt)$

According to **Faraday's law of electromagnetic induction**,
 rate of change of flux linkages is equal to the induced emf
 So, $E = N(d\Phi/dt)$ (volts)

4.4 Phenomenon Of Mutual Induction

Alternating current flowing in a coil produces alternating magnetic field around it. When two or more coils are magnetically linked to each other, then an alternating current flowing through one coil causes an induced emf across the other linked coils. This phenomenon is called as mutual induction.

5. ASSEMBLY AND WORKING

Coils and magnets are used to create Motors and Generators / Alternators. We will be looking at how wires and magnets interact to create power, both mechanical and electrical. It is the interaction between these two forces that needs an overhaul to counter the effects of global warming and pollution. With the higher cost of energy, the efficiency of these devices needs to be tuned. We need to get closer to 100 % efficiency so as not to waste so many natural resources to create the power we need to run the things that give us pleasure.

Now the magnets are placed with alternating north and south poles facing up which will create alternating current in the output of the alternator. But I intuitively felt there was a problem. And this is where I had to do some learning about magnets and coils. And what I found out was that when the magnet passes over the coil, as it first approaches the coil the current in the coil begins to flow in one particular direction. As the magnet begins to pass over the coil, half of the coil's current is trying to move in one direction and in the other half

of the coil; current is trying to move in the other direction. Nothing's going any ware. Now as the magnet exits the coil, Current begins to move in the opposite direction of when the magnet approached the coil.

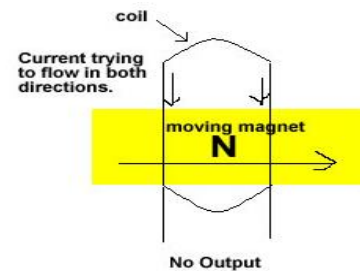


Fig. 5.1 Magnet passing over a flat coil

This means you only have current flow, and only a little at that, when the magnet is entering or exiting the coil. As it passes directly over the coil, when max output would be expected, close to zero output would be realized. Many of the more popular alternative energy sites on the net are using this particular design. The reason I suppose is that the magnets are rotating rather than the coils. If the coils were rotating then you would need some kind of a commutator. This for the home brewer would be difficult to manufacture. But don't take my word for it; let's look at how magnets and coil relate to each other.

Let's start from the beginning. Check out the image as shown,

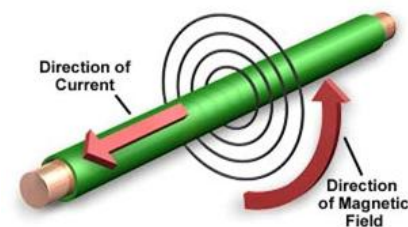


Fig. 5.2 Wire with a current flowing through it

The photo above describes a wire with a current flowing through it. The wire develops a rotating non polar magnetic field that has direction. Doesn't seem too important now but later you'll find out that this magnetic field is what keeps us all in chains.

Now let's look at the magnet. Check out the image as shown,

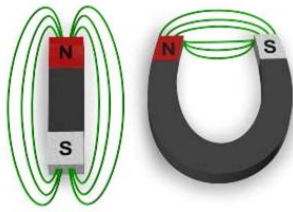


Fig.5.3 Magnetic flux is in relation to the magnet

Now to create electrical power we need that wire or coil to cut those lines of flux. But we also need to understand what happens when it does. The first thing we need to understand is that depending on how the magnetic flux is cut will depend on how much power is developed and in what direction current will flow. The way the coils above were cutting the magnetic flux you had current attempting to flow in both directions at once. Not a good design because you don't get much net power.

Above is an example of what I'm talking about. Here the magnet is inside the coil with the north pole effecting one half of the coil and the south pole effecting the other half of the coil. Here, in the photos below, is an example of coils rotating inside a magnetic field. This is a great design because the magnetic flux is drawn from the North Pole through the coil to the South Pole. Normally the coil would have a core of some kind which would further draw the magnetic flux through the coil, which would cause magnetic cogging between the magnets and the core, which would require greater torque to turn the alternator.

Now let's look at the interaction between the wire and the magnetic flux a little closer. Below is a photo that shows what's going on in a motor. This is called the left hand rule. This is for a motor where a voltage is applied to the wire. For a generator, the current flow created would flow in the opposite direction. So if you were attempting to create current flow you would move the wire in an upward fashion (for this example) which would cause current to flow counter to the direction of your middle finger.

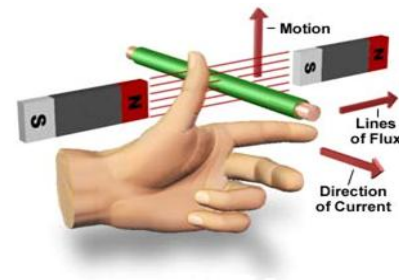


Fig. 5.4 Left hand rule

6. NEODYMIUM MAGNET

A neodymium magnet (also known as NIB or Neo magnet), the most widely used type of rare-earth magnet, is a permanent magnet made from an alloy of neodymium, iron and boron to form the $\text{Nd}_2\text{Fe}_{14}\text{B}$ tetragonal crystalline structure. Developed in 1982 by General and Sumitomo Special Metals, neodymium magnets are the strongest type of permanent magnet commercially available. They have replaced other types of magnets in the many applications in modern products that require strong permanent magnets, such as motors in cordless tools, hard disk drives and magnetic fasteners.



Fig. 6.1 Neodymium magnet

The tetragonal $\text{Nd}_2\text{Fe}_{14}\text{B}$ crystal structure has exceptionally high uniaxial magneto crystalline anisotropy (HA-7 tesla - magnetic field strength H in A/m versus magnetic moment in $\text{A}\cdot\text{m}^2$). This gives the compound the potential to have high coercivity (i.e., resistance to being demagnetized). This property is considerably higher in NdFeB alloys than in samarium cobalt (SmCo) magnets, which were the first type of rare-earth magnet to be commercialized. In practice, the magnetic properties of neodymium magnets depend on the alloy composition, microstructure, and manufacturing technique employed.

6.1 MAGNETIC PROPERTIES

Some important properties used to compare permanent magnets are:

REMANENCE (B_R)

This measures the strength of the magnetic field.

COERCIVITY (H_{CI})

The material's resistance to becoming demagnetized

ENERGY PRODUCT (BH_{MAX})

The density of magnetic energy

CURIE TEMPERATURE (T_C)

The temperature at which the material loses its magnetism.

7. INDUCTION COIL

An induction coil or "spark coil" is a type of electrical transformer used to produce high-voltage pulses from a low-voltage direct current (DC) supply. To create the flux changes necessary to induce voltage in the secondary coil, the direct current in the primary coil is repeatedly interrupted by a vibrating mechanical contact called an interrupter. Today their only common use is as the ignition coils in internal combustion engines and in physics education to demonstrate induction.

The term 'induction coil' is also used for a coil carrying high-frequency alternating current (AC), producing eddy currents to heat objects placed in the interior of the coil, in induction heating or zone melting equipment.



Fig. 7.1 Induction coil

A 36 AWG copper wire is used to make the induction coil which is wound on a dielectric material with 1000 turns and connected in series with other coils.

8. RECHARGABLE BATTERY (8V, 500MAH)

A rechargeable battery, storage battery, secondary cell, or accumulator is a type of electrical battery which can be charged, discharged into a load, and recharged many times, while a non-rechargeable or primary battery is supplied fully charged, and discarded once discharged. It is composed of one or more electrochemical cells. The term "accumulator" is used as it accumulates and stores energy through a reversible electrochemical reaction. Rechargeable batteries are produced in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of electrode materials and electrolytes are used, including lead-acid, nickel cadmium (NiCd), nickel metal hydride (NiMH), lithium ion (Li-ion), and lithium ion polymer (Li-ion polymer). Rechargeable batteries initially cost more than disposable batteries, but have a much lower total cost of ownership and environmental impact, as they can be recharged inexpensively many times before they need replacing. Some rechargeable battery types are available in the same sizes and voltages as disposable types, and can be used interchangeably with them.

In this project we are using two 4v battery which are serially connected to each other and form a 8V battery which also provide 500 mAh current.

9. FUTURE SCOPE

We are primarily developing the project for charging the cell phone on bicycle while travelling in remote place and it can be expanded by increasing the magnets and coils in quantity and reducing the space in between the disks on which magnets and coils are placed, by this maximum line of force is cut by the coil and flux fill generate more and induced voltage will be maximum. Using this project on motor cycle we can generate

maximum voltage which can be used to charge laptops, camera through battery. It can be also use to implement USB operated music player on bike with small speaker. And it is all frictionless which will not reduce the speed of motorcycle machines which are operated on the electricity like wheat mills can also be used to generate power by using the frictionless power generator, as it rotates continuously at uniform speed maximum power can be generated which will use to glow the lights and fan in that area.

10. Result and Discussion

From the various test on bicycle considering the speed of it we have got different output voltage, current, power. To measure the RPM we used tachometer and by using tachometer following results are listed below.

- 1) At RPM of 25 $V_0=4.5V$, $I=315mA$ and power output= $1.410W$.
- 2) At RPM of 35 $V_0=6.8V$, $I=400mA$ and power output= $2.720W$.
- 3) At RPM of 55 $V_0=9.2V$, $I=495mA$ and power output= $4.554W$.
- 4) At RPM of 75 $V_0=11.3V$, $I=750mA$ and power output= $8.475W$

As the voltage obtained from the assembly is varying in nature with respect to speed so for requirement of constant power supply we are using the battery which is first charge to maximum value and then it is utilized to charge the accessories. So for charging the battery continuously we require minimum constant revolution of 30 – 40 RPM and if rpm increases the output will be more.

11. CONCLUSION

We have successfully designed the project and implemented on the bicycle, the generated power is utilized to charge the mobile phones and mobile devices; we also understand the concept of electromagnetism and how to generate power by just placing the magnet and coil of equal quantity on different disks without making any contact. The voltage output taken from the assembly is totally dependent on the rpm of the wheels so voltage is fluctuating so a battery is used to provide a constant power supply to our cell phone. A battery connected to the generator assembly is continuously charged when bicycle moves at 10-40 rpm which is normal speed of bicycle. By this assembly battery is continuously charging and it gets fully charged in half an hour and the cell phone is

charged which takes 1 to 1:30 hour to get full charge. By using this project we are going remove the disadvantage of conventional power generator which make use of dynamo as a power generator which produces friction and decrease the speed of bicycle. In this project we have overcome this friction and produces clean energy.

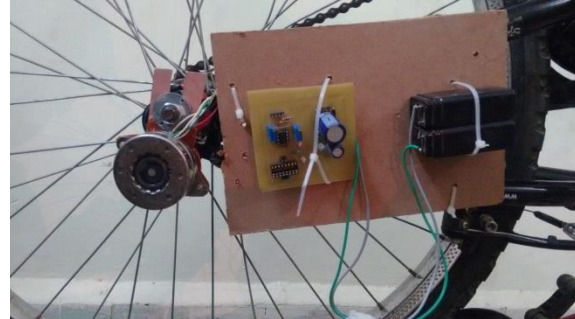


Fig 11.1 Prototype Design

12. Acknowledgements

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