Development of a Rotating Gate-Based Electricity Generation System

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Abstract **As global energy demands continue to rise, renewable energy sources and unconventional energy harvesting methods are becoming increasingly important for climate stabilization and reducing fossil fuel consumption. This study explores the feasibility of generating power using a revolving door, a novel approach to energy harvesting. A prototype revolving door was designed and fabricated, incorporating a gear, pinion, and motor mechanism to amplify the initial RPM of the door shaft. Experimental results show that the prototype can produce 4 volts, with output power dependent on the frequency of people passing through the door. The minimum output power of 1.564 watts was achieved at 13 RPM, while the maximum output power of 2.6 watts was reached at 23 RPM.**

I. INTRODUCTION

This project, "Development of a rotating gate based electricity generation system related introduction," explores a novel energy harvesting system that generates power from people passing through doors. As we move forward, it's essential to develop alternative energy sources to reduce our reliance on natural resources. Human physical activity, such as walking or running, can be converted into electrical energy. This concept inspired our project, which aims to capture and utilize the kinetic energy generated by individuals passing through a rotating gate. By harnessing this energy, we can reduce our dependence on non-renewable energy sources .

II. LITERATURE REVIEW

Although in all aspects of life are surrounded by energy, the ability to harness it and use it for constructive ends as economically as possible is the challenge before mankind. Energy produced from the conventional sources like coal, natural gas, furnace oil, high speed diesel, etc., are responsible for producing gases like CO2, NOX, SOX, etc. that causes global warming. Also, its sources are consumed much faster than nature can create them. Beside conventional sources of energy, there exist many alternative renewable energy sources1. The interest in this field of study comes from the undesirable effects of pollution, both from burning fossil fuels and from nuclear waste byproducts. Their means of harnessing energy, which have less damaging impacts on our environment. The possible renewable energy sources are solar, wind power, geothermal, tidal and hydroelectric. In 2030, the world energy consumption will be 721.5 quadrillion Btu5. It is a challenge to meet up such huge amount.

Also environmental pollution creates problems because of the excessive use of fossil fuel. Renewable energy such as solar energy, wind energy, energy generation from vibration by using piezoelectric materials is the best solution for over-come this problem. However, revolving door can be used as a new energy source of energy. Boon Edam developed an energy generated revolving door for the "Driebergen-Zeist" railway station in Netherlands10. That not only saves energy, but also generates energy with every person passing the doors. The station has a daily capacity of 8500 commuters and a calculation for this particular situation that indicated an energy saving of around 4600 kWh per year, a considerable saving compared to a conventional sliding entrance. The door uses a generator that harvests the kinetic energy when the door spins and a super capacitor to store the energy. The generator controls the rotating speed of the door for safety. The ceiling of the revolving door is made of safety glass and gives a clear view of the technology. A set of super capacitors stores the generated energy and provides a consistent supply for the low energy LED lights in the ceiling. When the lights use the stored energy from the door the main energy supply takes over. The station has a display that shows the amount of energy generated as the customers walk in and out. A report has analyzed the possibility of implementing energy-generating revolving doors in

the new Student Union Building (SUB) at the University of British Columbia by making a triple bottom- line assessment.

III. PRINCIPLES OF GENERATION

Alternating current is used to much greater extent than direct current. The machine which generates alternating current is called as alternator (or) AC Generator. Here we are used specially prepared small types alternator which is used to generate 500mA, 6V, 3W.

Principle of Alternator

The alternator works on the principle of faraday's law of electromagnetic induction, when there is cutting of magnetic flux by a conductor or when there is a change of flux linkage by a coil, an emf is induced in the conductor or the coil shows the simple arrangement of an alternator is shown in fig 2

If an open ended loop or coil of wire is rotated between the poles of an electromagnet as in emf is generated in the loop. The value of the emf varies both in magnitude and direction according to the instantaneous position of the loop. In one revolution of the loop through 360 electrical degrees, assuming that the strength of the field is uniform, the form of the emf wave is ideally that of a sine wave.

The variations of an alternating quantity through 360° are called a "cycle" and the number of cycles completed per second by an alternating quantity is called "frequency". The standard frequency 'f of the public supply is so hertz (HZ) or cycles per second. The practical form of the above machine is known as single face alternator. The alternator may also be warned to give 2-phase or 3-phase supply The stator consists of an iron ring made of laminated silicon steel alloy, with slots on its inner periphery to accommodate armature conductors. The stator is held in a cast iron or welded steel frame. To minimize eddy current losses, the stator core is laminated and insulated with paper or varnish.

Rotor

The rotor, also known as the field system, is similar to that of a DC generator. It is excited from a separate 12.5V or 250V DC supply, usually provided by a small DC shunt or compound generator called an exciter. The exciter is mounted on the alternator shaft and supplies exciting current to the rotor through slip rings and brushes. The field produced has alternating north and south polarities. The exciter's power rating is typically 0.3-1% of the AC generator's power rating, with a rated voltage between 125V and 250V.

1. Salient Pole Type: Characterized by large diameter and short axial length. Pole shoes cover about 2/3 of the pole pitch, and poles are laminated to reduce eddy current losses. Typically employed with hydraulic turbines or diesel engines, operating at 120-400 rpm.
2. Non-Salient Pole Type (Smooth Cylindrical Type): Features small diameter and long axial length. Benefits include less windage loss, better dynamic balancing, and quieter operation. Typically operates at 1000-30.

Production of Sinusoidal Alternating EMF

When the rotor is rotated by a prime mover, the armature conductors cut the magnetic flux, inducing an EMF due to electromagnetic induction. The EMF induced in the armature conductors varies simusoidally as the rotor rotates, resulting in a sinusoidal alternating EMF is opposite the middle of the poles. Induced emf depends upon the name of the pole influencing the conductor at any given instant. Thus an alternating emf is induced in the conductors which goes through one complete cycle in an angular distance equal to twice of the pole pitch though the shape of the alternating infused taken as anusoidal.

Frequency of induced E.M.F

If the number of poles on rotor of an alternator is pe than piz cycles of emf are completed in one revolution. The number of cycles per second known as frequency of will be equal to the product of number of cycles of emf for revolution and number of reduction mode per second by the rotor frequency.

N-1206/P

Therefore f=NP/120.

Where n is the number of revolutions made per second by motor,

(Or) f=PN/120

Where N is the number of revolutions made per minute by the rotor

Hence frequency of induced emf (or) Current induced in stator conductors depends upon the number of poles and speed of rotor. It is an alkaline cell the active materials of positive GATE consists of nickel hydroxide. The negative GATE consists of mixture of oxides of cadmium and iron the electrolyte is potassium hydroxide or caustic potash.

Both positive and negative GATEs consist of there. Hence perforated steel pockets, in which active materials are securely contained. The separators are them strips of polystyrene. They provide close spacing of GATEs. Active materials of the battery make the resistance of the battery very low. The complete plate group consists of numbers of alternate positive and negative plates. The entire plate assembly is places with in sealed steel container. Polystyrene is used for insulation. The changing of discharging of Nickel cadmium cell . Transfer resistor

When a third dapper element is added to crystal diode in such a way that two PN junctions are formed the resulting device is known as a transfer resistor.

It was invented by J. Bardeen and WH Brattain in 1948 at Bell laboratories USA. the property of a capacitor to oppose the change of voltage in the circuit. Its unit farad capacitors are used in electronic circuits.

1. To store electric charge.

2. To oppose any change in voltage.

3. To block DC.

4. To bypass AC.

5. To couple two circuits.

6. To filter unwanted electric signal.

15.5 Transformer

Basic construction and working principle of simple transformer is given below.

An elementary transformer consists of a soft iron or silicon steel core and two windings placed on it. The windings are insulated from both the core and each other. The core is built up of thin soft iron or silicon steel laminations to provide a path of low reluctance to the magnetic flux. The winding connected to the supply main is called the primary and the winding connected to the load circuit is called the secondary. Although in the actual construction the two windings are usually wound one over the other, for the sake of simplicity.

IV.WORKING OPERATION

When the primary winding is connected to an AC supply main a current flows through it. Since this winding links with an iron core, so current flowing through these with an iron core, so current flowing through these winding produces an alternating flux in the core. Since this flux is alternating and links with the secondary winding also, so induces an emf in the secondary winding The frequency of induced emf in secondary winding is the same as that of the flux (or) that of the supply voltage. The induced emf in the secondary winding enables it lo deliver current to an external load connected across it.

Construction

A transistor consists of two PN junctions formed by sandwiching either P type (or) N type semiconductor between a pair of opposite types. There are two types of transistors namely,

(1) NPN transistor

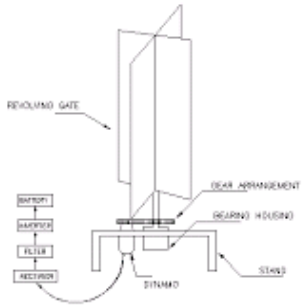
In each type of transistor

(ii) PNP transistor

1. There are two PN junctions. Therefore it is a combination of two diodes connected back to back

11. There are three terminals taken from each type of semiconductor.

III. The middle section is a very thin layer this is the most important factor in the transistor.



PHYSICAL CHANGES DURING CHARGE

Mostly in the alkaline group nickel cadmium cell finds more application. Hence study of this cell only is included.

The electrolyte used in this cell is potassium hydroxide (KOH). Under charged condition, the active materials is hydroxide of nickel (Ni (OH),) and that on the negative is pure cadmium (Cd).
The inverter is the heart of the UPS, since it determines the quality of power delivered to the served load. It converts direct current from the battery system to sinusoidal alternating current with fixed frequency and voltage.

A variable output voltage can be obtained by varying the input D.C. voltage and maintaining the gain of the inverter constant. On the other hand, if the input voltage is fixed and it is not controllable, a variable output voltage can be varying the gain of the inverter.

Functions of Inverter

The functions that must be performed by inverters used in static UPS are to,

➢ Convert D.C. into A.C.
➢ Provide an output voltage free of harmonics less than 5 percent.

➢ Maintain stable voltage inspire of variation of the load, of its power factor and of the battery voltage.

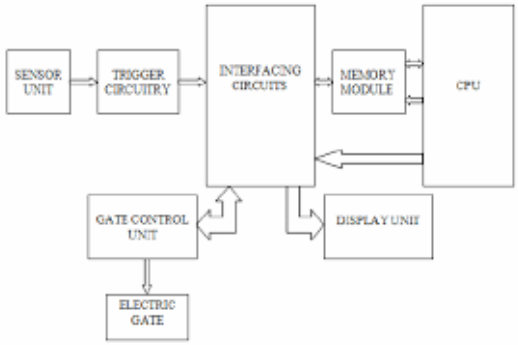
➢ Maintain stable frequency.

➢ Keep voltage transients within limits.
electronically . Materials Used for Gear Manufacture

The choice of material for gear manufacture depends on factors such as strength, wear resistance, and noise reduction. Both metallic and non-metallic materials are used.

Metallic Materials
1. Cast Iron: Widely used due to its good wearing properties, excellent machinability, and ease of producing complicated shapes.
2. Steel: Used for high-strength gears, steel can be plain carbon steel or alloy steel. Steel gears are often heat-treated to balance toughness and tooth hardness.
3. Phosphor Bronze: Used for worm gears to reduce wear, which can be excessive with cast iron or steel.

Non-Metallic Materials
1. Wood: Used for quiet operation and low-load applications.
2. Rawhide: Used for low-load applications and quiet operation.
3. Compressed Paper: Used for low-load applications and quiet operation.
4. Synthetic Resins (e.g., Nylon): Used for quiet operation and low-load applications.



Emitter
The section on one side that supplies charge carries is called emitter. The emitter is always forward biased so that it can be supply a large number of majority carriers. The emitter is heavily doped so that it can transfer more charges to the base.

Base

The middle section which forms two PN junctions between the emitter and collector is called the base. The base emitter junction is forward biased allowing low resistance from the emitter circuit. The base collector a junction is reversing biased and produces high resistance in the collector circuit. The base is lightly doped and it is very thin.

Collector

The section on the other side that collects the charges is called the collector. The collector is always reverse biased. Its function is to remove charges from its junction with the base. The collector is moderately doped.

Working of NPN Transistor

The NPN transistor with forward bias to emitter base junction and reverse bias to collector-base junction the forward bias causes the electrons in the N-type emitter to flow towards the base. The constitutes the emitter current IE. As these electrons flow through the P type base. They tend to combine with holes. As the base is lightly doped and very thin, therefore only a few electrons (less than 5%) combine with holes to constitute base current IB.

The remained (more than 95%) cross over into the collector current IC. In this way almost the entire emitter current flows in the collector circuit is the sum of collector and base currents.

V. DESIGN CALCULATION

While solar energy and other sources are often considered renewable, their lifespan is limited. In contrast, human energy is a virtually limitless and renewable source.

Calculating Kinetic Energy

Let's consider an example:

A 40kg person walks at a rate of 2m/s.

Kinetic Energy (KE) = 1/2 × m × v^2 = 1/2 × 40 × 2^2 = 80 joules

In this scenario, the person releases 80 joules of energy per second. If they continue walking for an hour:

Energy Released = 80 joules/s × 3600 s = 288,000 joules

This demonstrates the significant amount of energy that can be harnessed from human activity.

. 5.1 Forms of Energy

The universe comprises two primary forms of energy:

1. Kinetic Energy: The energy possessed by a body due to its motion.
2. Potential Energy: The energy possessed by a body due to its position.

5.2 Kinetic Energy

Kinetic energy is calculated using the formula:

Kinetic Energy (KE) = 1/2 × m × v^2

Where:

- m = mass of the body (in kg)
- v = velocity of the body (in m/s)

5.3 Potential Energy

Potential energy is calculated using the formula:

Potential Energy (PE) = m × g × h

Where:

m = mass of the body (in kg)

g = acceleration due to gravity (in m/s^2)

h = height of the body above the reference level (in m)

VI.CONCLUSION

First of all I thank everyone who contributed for the grand success of our project.

By doing our project we have gained at most knowledge. In addition, we are glad about our optimistic and creative thinking.

The project developed for the welfare of human lives has been dedicated to themselves as a TRIBUTE

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