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A Novel Miniature Wind Generator in Automobiles

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Abstract - **This paper presents a novel method to generate electrical energy in automobiles. The generator consists of an elastic belt which flutters in the presence of wind. The flutter in the belt can be converted to electrical energy. It works on the principle of Faraday's law of electromagnetic induction. As automobiles travel at high speed, they are a constant source of high speed wind. So, this method is suitable to generate energy and power the electronics in automobiles. As this method of wind energy generation does not consist of any mechanical rotating parts, it is highly efficient and cost effective.**

Keywords – *Aerodynamic flutter, Wind generator, Energy harvesting*

I. INTRODUCTION

The extraction of energy from the environment to power electronic devices has drawn a lot of attention in the recent decade. Sources such as solar, wind, radiation, human motion or temperature are tapped to generate energy to power these devices.

In this paper, the wind energy is tapped and converted to electrical energy in a novel way to power the electronic devices in automobiles. Automobiles provide a constant source of high speed wind and they utilize a lot of electronic devices. So the application of this technology in automobiles is the perfect choice.

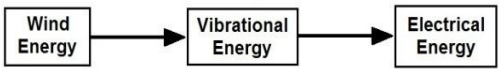

Fig. 1. Energy flow of the system

The system basically works due to the flutter produced in the elastic band in the presence of wind. This phenomenon is known as the *Aerodynamic Flutter*. This vibrational energy is used to vibrate a magnet attached to the belt. The magnet is placed between two coils. Due to relative motion of the magnet with respect to the coils, electricity is induced in the coils. This follows the Faraday's law of electromagnetic induction.

II. DESIGN OF THE DEVICE

Conventional wind energy generators use huge rotating blades to generate power. This device uses only an elastic band and magnet to harvest the wind energy.

An elastic band is fixed between two stationary ends. A magnet is attached to the belt and is configured to move along with it. The coils are placed near the magnet on either side. Hence, the motion of the magnet induces electricity in the coils due to change in magnetic field.

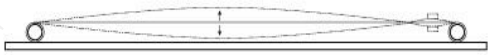

Fig. 2. Wind flutter generator by Shawn

Components:

1. Elastic Band
2. Permanent Magnet
3. Highly wound coils
4. Rectifier
5. Voltage regulator
6. Filter
7. Load

III. WORKING

The wind creates a flutter in the elastic bands that are placed next to each other. This flutter is used to oscillate the magnets between conducting coils. Due to the relative change in the magnetic field around the conducting coils, an EMF in inducted into the coil according to Faraday's law of electromagnetic induction. This EMF is alternating in nature. Hence a rectifier is used to convert it to DC. Then a regulator is included to maintain a constant voltage and supply it to the load.

The working of the system is depicted in the following circuit diagram.

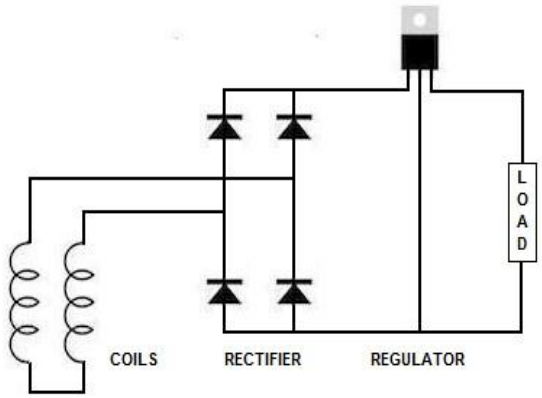

Fig. 3. Circuit for Wind Generator

The EMF equation is given by,

$$E = -N\frac{d\varphi_B}{dt}\ Volts$$

where,

E = Induced EMF
N = Number of turns in the coil
φ = Magnetic flux
t = Time

As we use a greater number belts and coils, a series and parallel connection of the coils are introduced. They are arranged efficiently so as to provide a greater amount of power to the load.

IV. POWER CALCULATION

The power density of the generator is a function of the following factors.

A. Wind Speed (U)

The Power of the system is directly proportional to the cube of the wind speed. Hence, any increase in the wind speed is highly advantageous to the power generation. As the proposed system is utilized in automobiles, high wind speed is guaranteed.

B. Air Density (ρ)

The generated power also depends on the density of the air. Power is directly proportional to the air density. Adequate density is required for proper generation of power in the system.

C. Coverage Area (A)

The area of the elastic belt on which the wind has effect is important. The power is directly proportional to this area. This linear relationship is limited to a particular range, beyond which there will be a steep decrease in power generation.

Power Equation,

$$P = \frac{1}{2} \times \rho \times A \times U^3\ Watts$$

This is the relationship between the Power density of the system with the Wind speed, Air density and the Coverage Area. This relation is limited to a particular range of Area of the Elastic belt.

V. TESTS AND RESULTS

The tests were conducted using a fan at low speed and the results were verified by testing on a two wheeler for high speed. Same results are expected for four wheelers and other vehicles.

Wind Speed (kmph)	Power (mW)
20	18.54
40	36.02
60	55.43
80	71.85
100	93.07

Table 1. Observation of the experiment

The observation of the experiment are summarized below. It can be seen that the power generated is almost linear to the wind speed. So, the wind speed is a major factor for power generation.

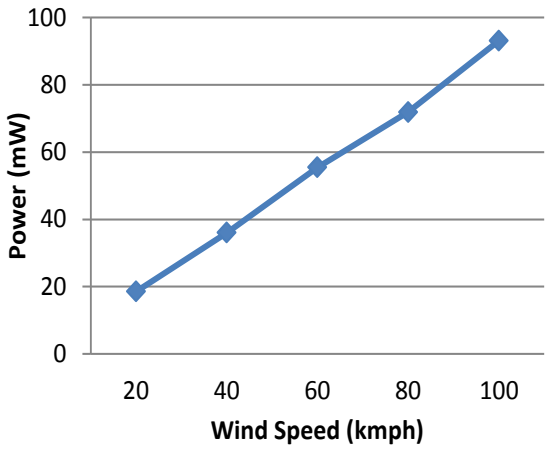

Fig. 4. Graphical Representation

The experimental model we used to test the system consisted of 5 coils and 10 magnets on either side for increased power generation when compared to a single coil and magnet. This arrangement produced almost double the power.

Fig. 5. Experimental model of Wind generator

VI. COST ANALYSIS

The following is the cost analysis of the various components required for the design of this system.

ITEM	COST (Rs)
Magnet (NdFeB)	1000
Elastic belt	750
Rectifier	100
Regulator	50
Miscellaneous	200
Total	**2100**

Table 2. Cost report

VII. CONCLUSION

The paper proposed a novel application for the wind generator where harvesting of energy is cost effective and profitable. The system can generate an average of 50 mW of power which is adequate for small scale electronic devices in automobiles such as sensors. The power output of the system can be enhanced by the use of stronger magnets and aerodynamic arrangement to ensure proper air flow. As the system regenerates the energy that is usually lost in the form of drag and utilizes it in a controlled manner, it is a case of *Free Energy Generation*.

In future, the project can be extended to increase power output and use the energy for applications such as mobile charging in the automobile.

VIII. REFERENCES

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