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DESIGN AND DEVELOPMENT OF MAGNETIC LEVITATING VERTICAL AXIS WIND TURBINE

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Abstract - *Renewable power generation system have been recently getting more and more attention due to the cost competitiveness and are environment friendly as compared to the fossil fuels and nuclear power generation. In recent years wind energy has become one of the most economical renewable energy technology. Today electricity generating wind turbines employ proven and tested technology and provide a secure and sustainable energy supply. The magnetic levitating vertical axis wind turbines have more advantages than that of conventional wind turbines in such a way that the blades of maglev wind turbines start rotating at a very low wind speed (approx 1.5m/s) and also it can be operated in a wind speed increasing 40m/s because of the negligible friction due to the magnetic levitation. Hence maglev wind turbine has a great future scope in terms of power generation. So the current project work is all about the design and fabrication of a prototype model of magnetic levitating vertical axis wind turbine and test it in different wind conditions.*

KEY WORDS: Magnetic Levitation, Wind Energy, Vertical Axis Wind Turbine, Neodymium Magnets

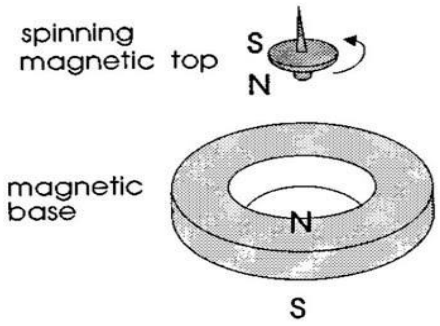
1. INTRODUCTION

Non-conventional energy is energy produced from renewable sources such as wind power, hydro power, solar power and various forms of biomass. Non-conventional sources of energy are more economic and sustainable because of there constant availability for use over and over. Wind energy is also one of the non-conventional renewable energy. There is a very important role of wind powered technology in power production. Wind power in India has a potential of 20000 MW. Wind turbine is the device which is used to generate electricity from the blowing wind. The wind turbine blades rotates when hit by the wind, then the spinning blades rotate a shaft which is further connected to a generator and produces electricity. The magnetic levitating vertical axis wind turbines are designed in such a way that there is almost negligible friction because there is no use of ball bearings. The main advantage of the magnetic levitating vertical axis wind turbine over other conventional wind turbine is that there is a very less(almost negligible) friction and it does not need any strong base support like other wind turbines and its maintenance cost is also very less. It requires very less space and it can be mounted almost every where like roof top of the houses. The vertically oriented blades of this wind turbine are suspended in the air without ball bearings with the help of repulsive force of magnets. This design makes it very efficient. The main aim of this project is to design a working model of magnetic levitating vertical axis wind turbine which can operate in both low and high wind conditions and could generate a decent amount of electricity.

1.1 PRINCIPLE OF MAGNETIC LEVITATION

Magnetic levitation is a method by which an object is suspended without any support with the help of the strong magnetic field. The repulsive force of magnets is used for reduction of effect of gravitational force. Due to this magnetic force there is are duction in the gravitational force and it is used to lift up the object in the air. By using this technique in vertical axis wind turbine there is a massive reduction in friction and the turbine blades start rotating at a very low wind speed.

The magnetic levitation phenomena operates on the repulsion characteristics of permanent magnets. By using two permanent magnets such as Neodymium magnets such that same poles facing each other the phenomena of magnetic levitation can be easily experienced. The force created due to this repulsion can be used to suspend the object is in the air without any other base support. In this project this principle of magnetic levitation is used to suspend the blades of the vertical axis wind turbine.



1.2 METHODOLOGY

The use of renewable energy sources to generate power is an approach to reduce our dependency on fossil fuels. Among various renewable energy resources, wind energy is one of them which is discussed in this paper. This project is all about the utilisation of wind energy to generate electricity.

The aim of this project is to design and implementation of a vertical axis wind turbine that could generate a decent amount of electricity in relatively low wind conditions. The main advantage of this project is that it can be placed in any place due to its smaller size and it can work in almost every wind conditions.

1.3 CONSTRUCTION

This project consist of heavy base stand in which the generator coil is internally fixed and a shaft is placed vertically in the centre of the base. This arrangement is also called as stator part. Coils are mounted on the stator part. There are two strong ring magnets(Neodymium magnets) are used. These ring magnets are placed such that the shaft is inserted in between these two magnets. One magnet is fixed on the stator part and the other is kept free to move along the vertical axis of the shaft. These magnets are placed such that same poles are facing each other so that magnetic levitation is achieved.

The other part is the rotor part which consists the blades between two plates. There is a few disc magnets are fixed in the bottom side of the rotor part. The rotor part is inserted in the shaft and suspended in the air due to the repulsive force of magnets and it is free to rotate. When the wind blows, the blades of the turbine rotate due to which magnets also rotate and the process of emf generation starts.

2. WORKING

By the principle of magnetic levitation the vertically oriented blades of the wind turbine suspended in the air by the repulsive force of permanent magnets. When the wind strikes the turbine blade ,the turbine blades rotates due to which the upper magnet and all the fixed magnets on the bottom of the rotor part start rotating. Due to this rotation of magnets above the fixed coils flux generates and cuts the magnetic field and as a result emf is generated in the coils. There are two wires extended from the coils which is in series of external connection to use power.

2.1 COMPONENTS

S.No.	Components	Material
1	Base Plate	Wood
2	Shaft	Stainless Steel
3	Ring Magnets	Neodymium
4	Disc Magnets	Neodymium
5	Coils	Copper
6	Blades	PVC

2.2 CALCULATION

The power generated from turbine depends on the kinetic energy produced

$$\text{Kinetic Energy} = 0.5Mv^2$$

The volume V of wind flowing in unit time through an area A, with wind speed v is denoted by Av and mass M is the product of Volume V and density ρ so,

$$M = \rho Av$$

Putting the M in equation of kinetic energy we get,

$$\text{Kinetic Energy} = 0.5\ \rho Av^3$$

But Power is nothing but the kinetic energy generated by the turbine.

Hence $\text{Power}=0.5\ \rho AV^3$

Where Air Density (ρ) = 1.225 kg/m^3 ,Area (A) = Swept Area of turbine blades, Velocity (v) = wind speed in m/s

3. RESULT AND CONCLUSION

By making this project we come to know that the energy generated by the wind turbine varies according to the wind speed or wind velocities. If the wind speed increases then the output voltage also increases and if the wind speed decreases then the output voltage also decreases. Also the power output of this wind turbine can be increased by increasing the number of coils used in the base plate.

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