

DESIGN AND FABRICATION OF MAGNETIC LEVITATING FRICTIONLESS VERTICAL WINDMILL

B.Joga Rao¹, M.Raja², B.Venkata Ganesh³, M.Rudrasekhar⁴, K.Nilesh kumar⁵

¹Associate professor, ^{2,3,4,5}U. G. Scholars, Department of Mechanical engineering
Godavari Institute of Engineering and Technology (Autonomous), Rajahmundry, Andhra Pradesh, India.

ABSTRACT: Wind energy is one of the renewable energy source, power generation by using wind energy is found to be multifold due to more demand and supply gap in electrical energy system. Magnetic levitation wind turbines have several advantages over conventional wind turbines. For instance, it is able to use winds with starting speeds as low as 1.5 meters per second (m/s) because of negligible friction achieved with the help of magnetic levitation created and due to the assistance from magnetic field. Also, the it could operate in winds exceeding 40 m/s. Hence maglev wind turbine has a great future potential in terms of energy generation. In this aspect the current project work would like to address certain design issues and proposes to design, fabricate and test a prototype of magnetically levitated vertical axis wind turbine providing stated advantages, the prototype will be fabricated and tested for the outcome.

KEY WORDS: Magnetic levitation, Vertical wind turbine and generator, Wind energy, Neodymium magnets

I. INTRODUCTION:

Wind power Technology has played a significant role in power production. The wind turbine is used for converting kinetic energy of wind into electrical energy. The wind with velocity strikes the blades, then the wind spin a shaft, which connects to a generator and produces electricity. The Magnetic levitating vertical wind turbine is designed in such a way that it reduces the friction. The main advantages are that it is frictionless and it uses magnetic levitation and it does not need to vast spaces required by more conventional wind turbines. It also requires little maintenance if required. The unique operating principle behind this design is through magnetic levitation which is supposedly an extremely efficient system for wind energy. The vertically oriented blades of the wind turbine are suspended in the air replacing any need for ball bearings. The aim of this project is to design and implement a magnetically levitated vertical axis wind turbine system that has the ability to operate in both low and high (1.5m/s to 40m/s) wind speed or velocity conditions. This new model of wind turbine uses magnetic levitation to reduce the internal friction and this magnetic levitating frictionless vertical wind turbine produces more energy than a conventional turbine, at the same time decreasing operational costs by 50% over the traditional wind turbine. Hence this technology provides an extreme efficient, versatile and elegant method of producing power from wind with nearly zero pollution. The choice for this model is to showcase its efficiency in varying wind conditions as compared to the traditional horizontal axis wind turbine and contribute to its steady growing popularity for the purpose of mass utilization in the near future as a reliable source of power generation. Hence the main objective of this project is to harness wind energy in more efficient way with frictionless magnetic levitated operation.[1]

II. Principle of magnetic levitation:

Magnetic levitation (Maglev) 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 used for reduction of effect of gravitational force significantly. Magnetic force is used for reducing of gravitational force and to lift up the objects in air. By this technique implementation of this vertical axis wind turbine is used for having negligible friction and there by the wind turbine starts rotating at lower wind speeds[2].

Also known as magnetic levitating, this phenomenon operates on the repulsion characteristics of permanent magnets. This technology has been predominantly utilized in the rail industry in the Far East to provide very fast and reliable transportation on maglev trains and with on-going research its popularity is increasingly attaining new heights. Using a pair of permanent magnets like neodymium magnets and substantial support magnetic levitation can easily be experienced. By placing these two magnets on top of each other with like polarities facing each other, the magnetic repulsion will be strong enough to keep both magnets at a distance away from each other. The force created as a result of this repulsion can be used for suspension purposes and is strong enough to balance the weight of an object depending on the threshold of the magnets. In this project, it is used to implement this technology form the purpose of achieving vertical orientation with the axial flux generator.

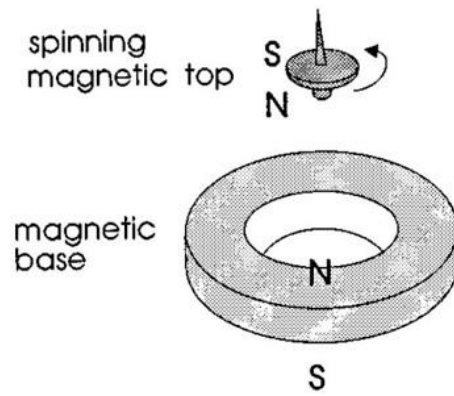


Fig.1-Levitation principle

III Methodology:

The exploration of renewable energy is an approach to reduce our dependence on fossil fuels. Among many renewable energy resources, wind energy is the only resource that will be concerned in this paper. The project focuses on the utilization of wind energy as renewable source which produces clean and safe source of electricity. Many designs have been proposed in order to create high efficiency wind turbine.

The aim of this project is to design and implement a magnetic levitated vertical axis frictionless wind turbine. The main advantage is to make this prototype is, it can be implemented undermost working environmental conditions on any place or buildings and can be work in less wind. We selected this project to generate electricity. Power generation is directly proportional to size of assembly which majorly includes number of blades, number of magnets and number of coils.

The basic prototype was made as per the calculations by using the components available in local market. The solid stable shaft was mounted on the base. The lower acrylic plate consists of copper coils fixed above on it. Another hollow oriented shaft was putted through the fixed solid shaft over which upper acrylic plate was mounted. Two big permanent ring magnets were attached between the two plates. The vertically oriented blades were attached to the rotating hollow shaft. The wind turbine blades were rotated due to the force produced by wind, which leads to the rotation of the wind turbine and shaft assembly which consist of neodymium magnets. Due to this, magnetic lines were cut by generator coils, through which magnetic flux get generated and produces EMF. The generated output EMF is measured by multi-meter.[2]

IV. Construction:

The implementation of this project consist of heavy base stand in which the generator coil is internally fixed on which a shaft is placed. There are two magnets(neodymium) used in this project. One magnet is fixed on base stand is known as lower magnet over which another magnet is arranged in such a way that the principle of magnetic levitation is accomplished. The shaft (delrin shaft) is inserted into the two magnets and connected to the generator coil. Blade holder plates are used to hold the blades, the unit is known as wind turbine and this wind turbine is mounted on upper magnet when the turbine rotates by the wind sources upper magnet also rotates[3].

V. Working:

By the principle of Maglev, the vertically oriented blades of wind turbine suspended in air above the base by permanent magnets which produces magnetic force to lift up the blades. This system does not require ball bearing. When wind with high velocity impacts on the turbine blades, the turbine rotates by which upper magnet also rotates. Due to rotation of the plate flux generates due to set up and cuts the magnetic field. Since EMF is generated in the coil. There are two wires extended from the coil or generator which is in series for external connection for use power.



Fig.2-Magnetic levitating wind turbine

VI.Components :

Table 6.1 gives components description.

SR.NO	COMPONENT	MATERIAL
1	Base plate	Mild steel
2	Shaft	Delrin
3	Magnets	Neodymium magnets
4	Motor mounting plate	mild steel
5	Blade holder plate	Mild steel
6	Wind mill blade	Aluminum
7	Pipe	Mild steel

VII. DESIGN OF WINDMILL :

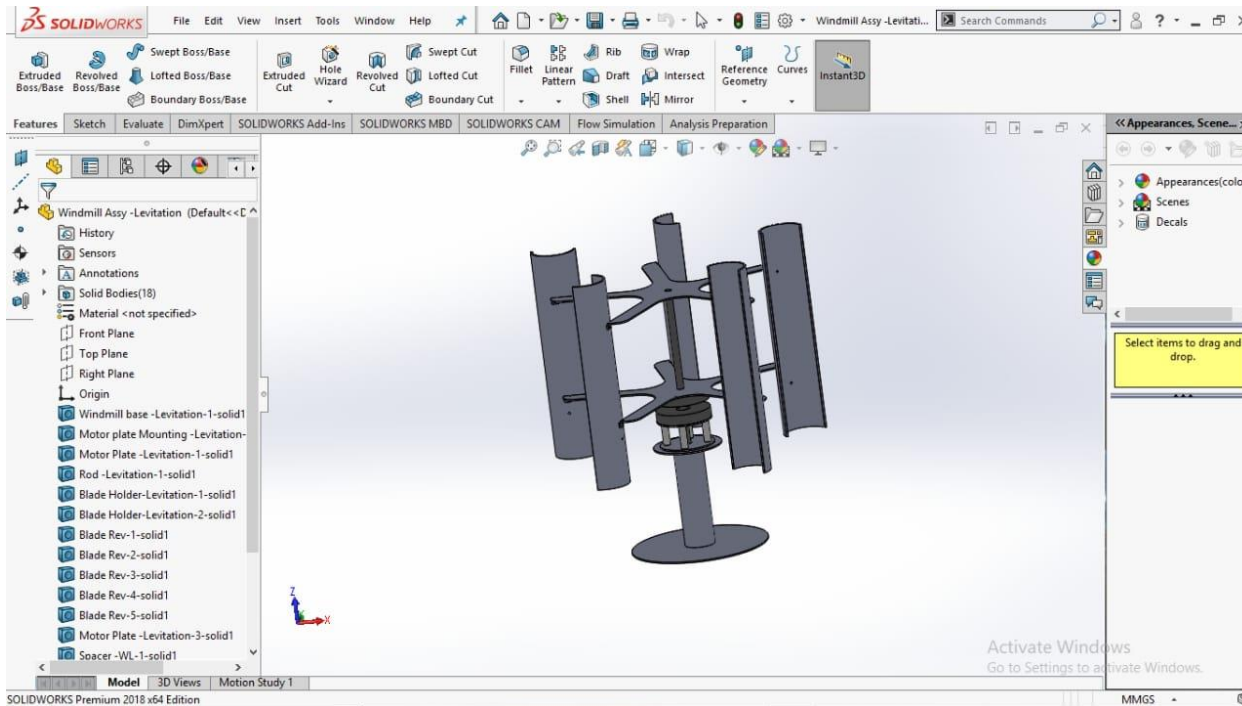


Fig.3-Assembly of windmill

The design of magnetic levitating frictionless vertical wind turbine is drawn in solid works 2018 software and we fabricated as proto type.

VIII. CALCULATIONS :

The power from turbine is related to the kinetic energy produced.

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

The volume V' 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/m³

Area (A) = Swept Area of turbine blades

Velocity (V) = wind speed in m/s[4]

IX.RESULT AND CONCLUSION:

By making this project we come to know that the output of wind turbine is varies according to the wind speeds or wind velocities.If the wind velocity increases then the output voltage also increase and vice versa.The voltage that can be generated is used to drive the loads like bulb,fan etc.

Measurement of the angular speed of wind turbine is done by using the non contact pipe tachometer to measure the rpm of wind turbine.with help of this measurement we can measure output voltage by using voltmeter.

Output power when loaded

Table.9.1- gives the output of the wind power

SR NO	SPEED OF THE TURBINE (IN RPM)	OUTPUT VOLTAGE (IN VOLT)	ANGULAR VELOCITY (RAD/SEC)	POWER IN WATTS
1	25	1.72	2.57	0.51
2	50	3.49	5.2	4.59
3	75	5.26	7.81	15.65
4	100	7.0	10.4	37.2
5	120	8.4	12.5	64

The major advantages of using wind as a source is very cheapest and it is natural power source that can be economically used to generate electricity. This is a power source that is non-polluting and clean. Noise factor is relatively less which can be assumed to be negligible, so Maglev wind turbine helps to reduce noise factor comparatively than other wind turbines. It does not require any lubrication. This wind turbine can accept the wind flow from any compass to rotate the blade.[5]

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