

FRICTIONLESS WIND TURBINE USING MAGNETIC LEVITATION

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Abstract: This paper focusses on magnetic levitation of wind turbine for power generation. Magnetic levitation (Maglev) is a method by which an object is suspended without any support with the help of strong magnetic field. Vertically oriented blades of the wind turbine are suspended in the air above the base by using neodymium magnet which produces magnetic force to lift up the plates. By the principle of magnetic levitation, the friction is less in wind turbine. The system requires wind for operation and does not requires the electricity to operate because no electromagnets are involved. It can operate in wind speed as low as 1.02 m/s. This technology provides efficient output for power generation as compare to other wind turbine.

Keywords: *Magnetic Levitation, Vertical axis wind turbine, Magnetic field, Neodymium magnets.*

I. Introduction:

Wind Power Technology has played a significant role in power production since decades. It is the cheapest available energy resource. Wind Power has become essential to use and can now be considered as a valuable supplement to conventional energy sources. Use of non-renewable sources is not sustainable because they take billions of years for formation. Example: According to BP, 53 years of oil left at current production rate [5]. So these non-renewable sources, not only are in short supply but also extremely harmful to the environment. For centuries farmers have used windmills to harness the wind for benefit of mankind. Wind Turbine converts kinetic energy of wind into mechanical power. Mechanical power can be used for specific tasks such as grinding grain or pumping water. Generator helps to convert mechanical power to electricity. The project dwells on implementation of a vertical axis wind turbine for the generation by using magnetic levitation. Maglev Wind Turbine was first presented at the Wind Power Asia Exhibition in Beijing 2007[1]. India was the first country in Asia to develop wind power on a commercial scale. In July 2015, India had installed 23,588 MW and is one of the countries in the world with most wind power on line. Currently, wind power has become commercially viable in India and the fact that 99 per cent of the investments in wind power are made by the private sector is a good indicator that wind power are made by the private sector is a good indicator that wind power can successfully compete with order sources of energy [2]. The Wind Turbine is suspended without any support with the help of strong magnetic field, so it has less friction while rotating which is one of the merit of this Wind Turbine. This Maglev Wind Turbine give more efficient output than any other horizontal axis Wind Turbine.

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.

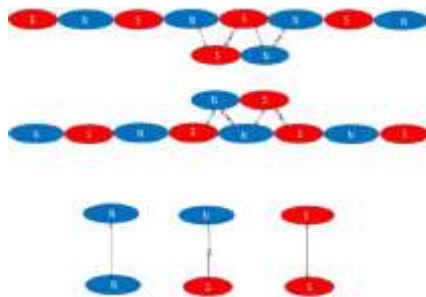


Fig.1 Magnetic Levitation Technology (Maglev)

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 upper plate which consist of small magnets. Due to this, magnetic lines were cut by coils, through which magnetic flux get generated and produces EMF. The generated output EMF is measured by multi-meter.



Fig.2 Magnetic Levitational Wind Turbine

IV. Construction:

The implementation of this project consist of heavy base on which a shaft is punched centrally. Two plates are used i.e. upper and lower plate which is mounted on shaft. Upper plate having 24 small magnets which are attached in round shape which is placed alternatively north-south systematically and one neodymium ring magnet which is mounted centrally on the bottom face. Lower plate is fixed on the base. There are 12 coils of copper are attached to it. Each coil has 280 turns and they are connected in series. Turbine is mounted on the upper plate. When the turbine rotates by the wind sources, upper plate also rotates.

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 as a source impacts on the turbine blades, the turbine rotates by which upper plate 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 which is in series for external connection for use power.

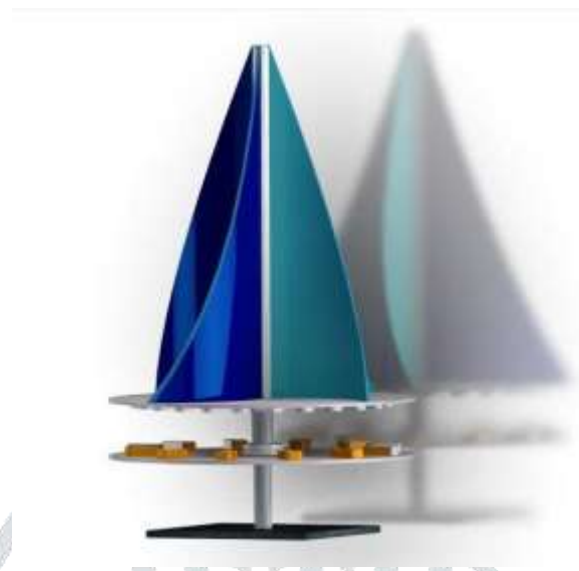


Fig.3 CAD Model of Magnetic Levitational Wind Turbine

VI. Components:

Table 6.1: Components used for implementation of frictional less wind turbine.

SR. NO	NAME	MATERIAL	DESCRIPTION
1	Base	Mild Steel	The main function of base is to support the all components of turbine and reduce the vibration of component.
2	Shaft	Aluminum	It is fixed and connected to the base.
3	Blades	Galvanized iron	This turbine blade shape is aerodynamic foil shape.
4	Acrylic plate	Acrylic plastic material	It is excellent optical clarity, low allowable

			shrinkage, good impact strength.
5	Neodymium ring magnets	Allow of Neodymium, iron, boron and few transition metals	These magnets are rear earth magnets, which lose no energy through friction. These magnets are extremely strong. This magnet is of grade 45.
6	Neodymium disc magnet	Allow of Neodymium, iron, boron and few transition metals	These magnets are small circular in size and they are used for attraction and repulsion. grade used is 45.
7	Coil	Copper	It is the good conductor of electricity and heat. Thermal conductivity of coil is high. The thickness of copper coil is 25 gauge.

VII. Calculations:

$$\text{Kinetic Energy} = 1/2 MV^2$$

The volume of air passing in unit time through an area A, with speed V and its mass M is equal to the volume V multiplied by its density ρ

$$\text{Therefore, } M = \rho V \text{ Substituting the value of M in equation above we get, } = 1/2 (\rho V)^2 = 1/2 \rho^2 V^3$$

Where,

$$\rho = 1.225 \text{ kg/m}^3 \quad V = 2.33 \times 10^{-3} \text{ m}^3 \quad \omega = 2\pi n \quad n = 1/60 \text{ rev/s}$$

With the above equation, the power generation can be calculated.

$$\text{Where: } \omega = 2\pi/60$$

$$= (2 \times 25)/60 = 2.16 \text{ rad/s}$$

$$\text{Kinetic energy} = 1/2 \times M \times V^2$$

Where,

$$M = \rho V$$

$$V = A \times l$$

$$= \frac{1}{4} \times (0.26)^2$$

$$= 0.053^2$$

$$= \frac{1}{2} \times 1.225 \times 0.053 \times (2.61)^3$$

$$= 0.577 \text{ watt}$$

VIII. Result and Conclusion:

Table 8.1: Output power when loaded

Sr. No.	SPEED OF TURBINE (in rpm)	OUTPUT VOLTAGE (in volt)	ANGULAR VELOCITY (rad/sec)	POWER (in watts)	CURRENT (In amp)
1.	25	1.77	2.61	0.577	0.32
2.	50	3.55	5.23	4.64	1.30
3.	75	5.32	7.85	15.70	2.95
4.	100	7.10	10.47	37.25	5.23
5.	120	8.40	12.56	64.32	7.65
6.	150	9.75	15.70	125.62	12.88
7.	200	12.00	20.94	298.06	24.83
8.	250	15.94	26.17	581.82	36.5
9.	300	21.23	31.41	1005.97	47.38
10.	350	27.45	36.65	1598.09	58.21

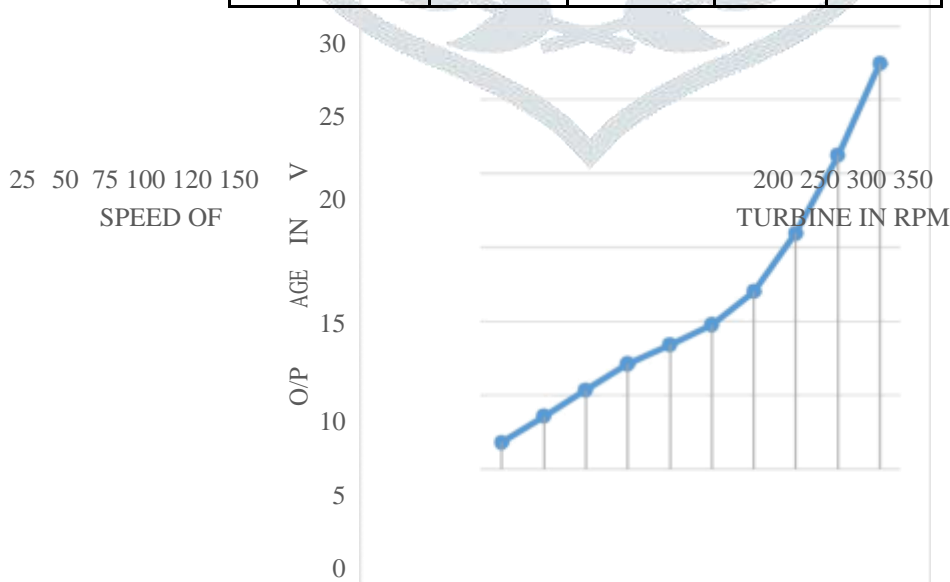


Fig 8.1 Graph of O/P Voltage VS Speed of Turbine

Measurement of the angular speed of wind turbine is done by using non-contact type tachometer to measure the rpm of turbine. By this measurement we can measure output voltage by using volt meter. during the measuring of speed also measure the voltage by using volt meter.

The biggest advantages of using wind, 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.

IX. Reference:

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