International Journal of Research in Engineering, Science and Management
Volume-2, Issue-11, November-2019
www.ijresm.com | ISSN (Online): 2581-5792

Design and Fabrication of Maglev Windmill

Suraj Takale[1], Brijesh Patil[2]
[1]Student, Department of Mechanical Engineering, MIT College of Engineering, Pune, India
[2]Professor, Department of Mechanical Engineering, MIT College of Engineering, Pune, India

***Abstract*: The basic principle of operation of a maglev windmill or a vertical axis turbine is similar to conventional windmill, but the blade design and axis of blades is different than the conventional windmill. The proposed model of windmill aims to reduce frictional losses during power generation. To do this, the implemented system uses the very basic principle that is magnetic levitation. Using strong neodymium magnets, the blades are kept levitating and the blade design enables to utilize the wind from any direction.**

***Keywords*: Vertical axis turbine, maglev windmill, windmill, Renewable sources, savonius, darrieus.**

1. Introduction

Wind is a form of solar energy. It is a natural power source that can be economically used to generate electricity. The reason behind wind is creation is uneven heating of atmospheric air caused by the sun. With the uneven heating of the sun, rotation of the earth and the rockiness of the earth's surface winds are formed. Wind energy or wind power describes the process by which the wind is utilized to generate mechanical power or electricity. Wind turbines converts the kinetic energy of the wind into mechanical energy. This mechanical energy can be used for different tasks (such as grinding grains or water pumping) or a generator can convert this mechanical energy into electricity.

A. How Maglev Windmill Works

Maglev windmill uses wind to rotate these specially designed blades and these blades are mounted on a rotor which rotates and produces electricity.

B. There are two types of windmills

Darrieus Turbine Type: French aeronautical engineer, Georges Darrieus invented this turbine. Darrieus type blades use lift forces from wind to rotate the blades. The blades have an airfoil shape, and instead of being oriented horizontally as they would be on an airplane, they are oriented vertically.

Savonius Turbine Type: Finnish engineer Sigurd Savonius invented the Savonius model. Savonius type blade design uses aerodynamic drag from wind to rotate the blades and produce power. Savonius type blades are rugged and simplistic in design. These can reduce costs since they are easier to manufacture, needless maintenance, and can last longer in harsher environments. However, they are roughly half as efficient as other lift type such as the Darrieus designs.

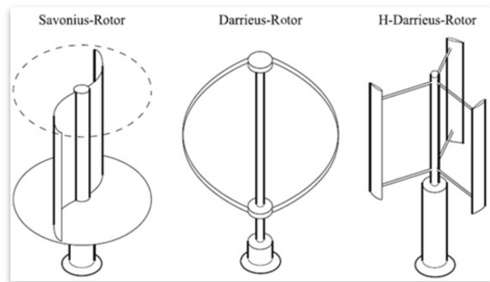

Fig. 1. Diagram shows different types of windmills

2. Design and fabrication of maglev windmill

The solar energy, tidal energy, wind energy, geothermal energy are the new options with much greater advantage. These non-conventional and renewable energy sources are alternate solution and these sources are eco-friendly.

All wind turbines essentially work the same way with a little bit of modifications depending on size and configuration of a windmill. The wind turns the blades which are mounted on a shaft to spin a shaft which connects to a generator which produces electricity. The rotors harness the kinetic energy of the wind and coverts it into mechanical energy which is then converted to electrical energy. Now a day to increase the efficiency of the VAWTs (Vertical Axis Wind Turbines) i.e. to reduce the frictional losses the magnetic levitation technology is used. The rotor is stator and the stator is rotor in this type of system. The blades are suspended using magnetic levitation technique and the coils through which current is generated are kept steady which is exactly opposite of a generator. The basic operation principle is like the HAWTs (Horizontal Axis Wind Turbines)

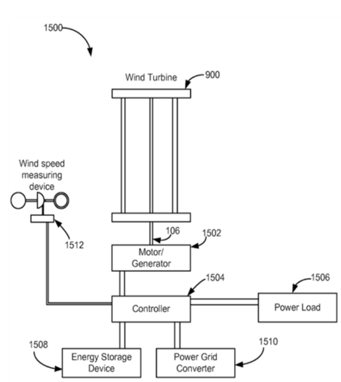

Fig. 2. Design and fabrication of maglev windmill

A. *Magnet selection*

If shape of magnets considered where ring or circular, they can be placed on shaft with same poles facing each other enabling repelling force to provide support to weight of turbine which minimizes use of magnets required to fulfil the idea. Two rings shaped neodymium (NdFeB) magnets are arranged at middle of shaft by which necessary suspension between stator and rotor are obtained.

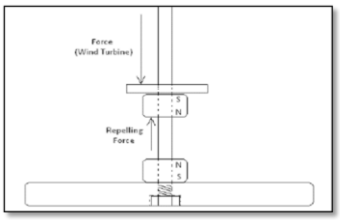

Fig. 3. Diagram show the magnet placement

B. *Coil design and arrangement*

To design the definite number of turns per coil is difficult. If the more turns are wound it increase the emf generated from each coil but increase the size of every coil. For minimizing the size, wire having higher gauge can be used. If the diameter of wire is small low amount of current flows leading to heating of wire because of the increased resistance of wire which another difficult task.

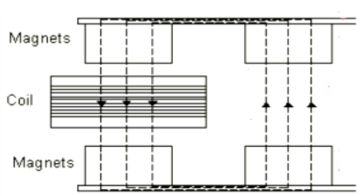

Fig. 4. Coil design and arrangement

C. *Blade design*

Savonius type blade design with little modification is used because they are rugged and simplistic reducing cost. The manufacture is easier, less maintenance, and durable in harsher environments.

D. *Working model:*

The below diagram shows the working model of a maglev windmill which can produce 1.1 V of electricity.

Fig. 5. Working model

3. Calculations

Kinetic Energy = $^1/_2$ MV^2

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

M= ρAV

Substituting the value of M in equation above we get:

Kinetic Energy=$^1/_2$ (ρAV) V^2

Kinetic Energy=$^1/_2$ ρAV^3

A non-dimensional proportionality constant k is introduced to convert the energy to kilowatts, where,

K = 2.14×10^{-3}

Therefore, Power in KW

(P) = $2.14\rho AV^3\times10^{-3}$

Where:

Air Density (ρ) = 1.2 kg/ 3/2.33x 10−3 slugs/f^3

Area (A) = Area swept by the blades by the turbine

Velocity (V) = wind speed in m/s

4. Conclusion

After completion of the working model, the output voltage given by the vertical axis maglev windmill was 7.1–8.2 millivolt. The windmill can accept wind from any direction, and it can be fixed on lower height. Power generated from this turbine can be utilized in remote places where traditional method of supplying power is costlier. Power generated from turbine can be efficiently used for Street/domestic lighting and domestic appliances. The vertical axis wind turbine with magnetic levitation may be mounted on residences. Here it can be erected on rooftop with very efficient and practical approach. The standard windmills having set of 1000 windmills can power up to 5 lakhs homes while single maglev windmill is capable supplying power to 5 thousand homes.

Abbreviations

VAWTs - Vertical Axis Wind Turbines
HAWTs - Horizontal Axis Wind Turbines

References

[1] Minu John, Rohit John, Syamily P. S, Vyshak P. A, "Maglev Windmill."
[2] Harshal Vaidya, Pooja Chandodkar, Bobby Khobragade, R. K. Kharat, "Power Generation Using Maglev Windmill."
[3] learnmech.com/design-and-fabrication-of-maglev-turbine-project/
[4] https://www.slideshare.net/RahulMehra35/maglev-windmill-project-
[5] https://www.researchgate.net/publication/319449533_POWER_GENERATION_USING_MAGLEV_WINDMILL