

Wind Turbines powered by Magnetic Levitation Wind Generators

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Abstract

The main goal of the paper is to design a windmill that does not require a generator or ball bearings and produces the maximum amount of power. One of the oldest methods for harnessing renewable energy is the use of wind energy for energy generation. Renewable energy is a critical component of socioeconomic development and economic expansion. Magnetic levitation technology is used to introduce a vertical axis wind turbine (VAWT) to improve performance. The system makes use of the permanent magnet's nature as a replacement for ball bearings to levitate the turbine component and so reduce energy losses when spinning, which is a key issue that can also be solved by using a normal wind turbine. The Maglev Wind Turbine is expected to push wind energy technology forward. In addition, the system can be used in more rural and urban areas of low-speed regions. The use of magnet materials in wind turbine system design will be discussed. An axial flux generator, which uses permanent magnets and a set of coils to generate power, will then be used.

Keywords: VAWT, Magnetic Levitation, Wind Turbine, Blade hub, Magnet.

INTRODUCTION

The suggested magnetic levitation wind turbine's construction and concept are introduced in the maglev power generation for better wind energy utilisation. The

magnetic levitation wind turbine offers the advantages of no mechanical contact, no friction, and little dampening, allowing the wind turbine to start up with low-speed wind and function with breeze. In order to

improve efficiency, magnetic levitation (Maglev) is incorporated into the turbine system. When the efficiency of a wind turbine is improved, more electricity is generated, reducing the need for expensive, polluting power generators.

A. Wind Energy:

Wind is classified as a type of solar energy since it is caused by the sun's uneven heating of the atmosphere combined with the abstract topography of the earth's surface. Local and planetary winds are the two types of winds that are significant to the applications of wind turbines.

The latter is the most prevalent, and it is frequently a decisive factor in the location of highly efficient wind turbines. There are several reasons to advocate the use of wind energy to generate electricity.

The amount of wind power available in the sky much exceeds current global energy usage. Because the resource available is significantly more than any feasible way to produce it, the utilisation of wind power is only restricted by economic and environmental constraints. Wind-generated renewable energy has received a lot of attention and support in recent years. Green energy, on the other hand, is

frequently chastised for its poor production and unreliability.

B. Wind Turbine:

The basic operating concept of a wind turbine is that as air flows swiftly in the form of wind, the turbine blades catch the kinetic energy of the wind. The blades begin to revolve and spin a shaft that runs from the rotor's hub to a generator, which generates power. In general, there are two sorts of wind turbines based on the axis around which they rotate.

Horizontal axis wind turbines have a primary rotor shaft and an electric generator at the top of the tower, pointing in the direction of the wind.

The majority of them have a gearbox that converts the turbine blades' sluggish revolution into a quicker rotation appropriate for driving an electrical generator. The primary rotor shaft is vertically oriented to allow the turbine blades to revolve without facing the wind.

The generator and gearbox are located in the ground rather than on the roof with this setup. There is no need for a tower to support it, making it easier to maintain.

C. Magnetic Levitation:

Magnetic levitation is a way of suspending an item using just magnetic fields as a support. The generated magnetic force is utilised to resist the forces of gravity and elevate the item. The magnetic repulsion between these two magnets will be strong enough to keep them at a distance from each other if they are placed on top of each other with like polarities facing each other. There are several advantages to using magnetic levitation, including the reduction of friction, the creation of force measurement, design, and entertainment gadgets. This cutting-edge technology has recently been adapted to a transportation system in which non-conducting vehicles are hung, directed, and pushed above a guide way by magnetic fields. The idea of a magnetically levitated vehicle sparked the development of practical applications in industries like power generating.

D. Maglev Wind Turbine:

The wind turbine's vertically oriented blades are hung in the air above the machine's base using a permanent magnet that generates magnetic force to pull the blades aloft.

Because there are no electromagnets in this system, it does not require power to work. There is no need for a ball bearing

to keep the turbine blades in place since they are suspended by the magnetic force produced by the permanent magnet. As a result, the friction between the blades and the ball bearing is greatly decreased, resulting in little energy waste. This also aids in lowering maintenance expenses and extending the generator's lifespan.

METHODOLOGY

- Choosing the proper magnet for a strong repulsive force and the right materials for rotor blades.
- Choosing the right materials for components and using them in the right places.
- Creating the prototype and putting it through its paces.
- The maglev wind turbine is being built.
- The functioning model of a maglev wind turbine is being tested.
- If any mistakes or unsatisfactory results are discovered, examine the model and recommend appropriate design improvements or other changes as needed.
- After the adjustments, you'll get the final model.
- Installation of the model in the proper location.

WORKING PRINCIPLE

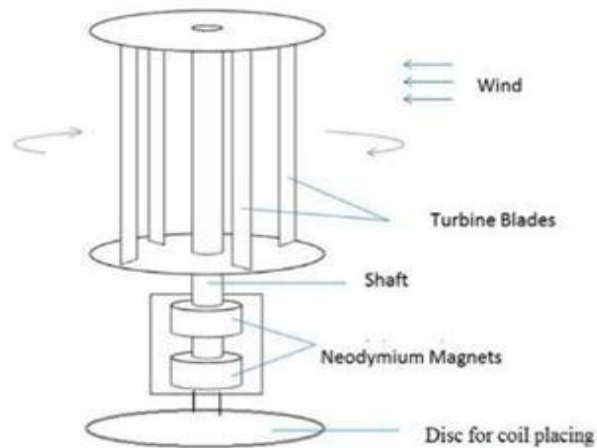


Fig.1. Sketch and components of maglev wind turbine

This is a general schematic diagram of a magnetic levitation vertical axis wind turbine that generates power by applying Faraday's first law of induction, which states that "Whenever a conductor is placed in a varying magnetic field, emf is induced, which is called induced emf, and if the conductor circuit is closed, current is induced, which is called induced current." Wind energy drives the wind turbine blades, which are attached to a disc and to which magnets are attached, and the magnetic flux of these magnets is linked to the coil on the maglev wind mill's base.

The following block diagram shows how the current is generated.

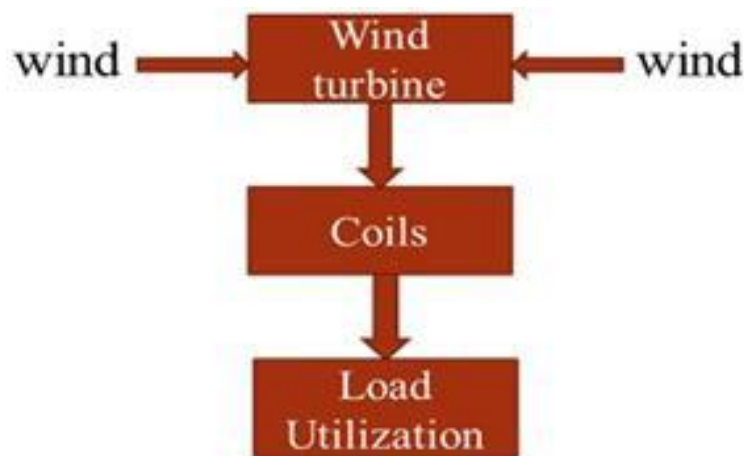


Fig.2. Block diagram of maglev wind turbine

DESIGN AND FABRICATION

We utilised the programme Solid Edge for the CAD drawings, and each component was independently sketched on the part design before being integrated in the assembly sheet.

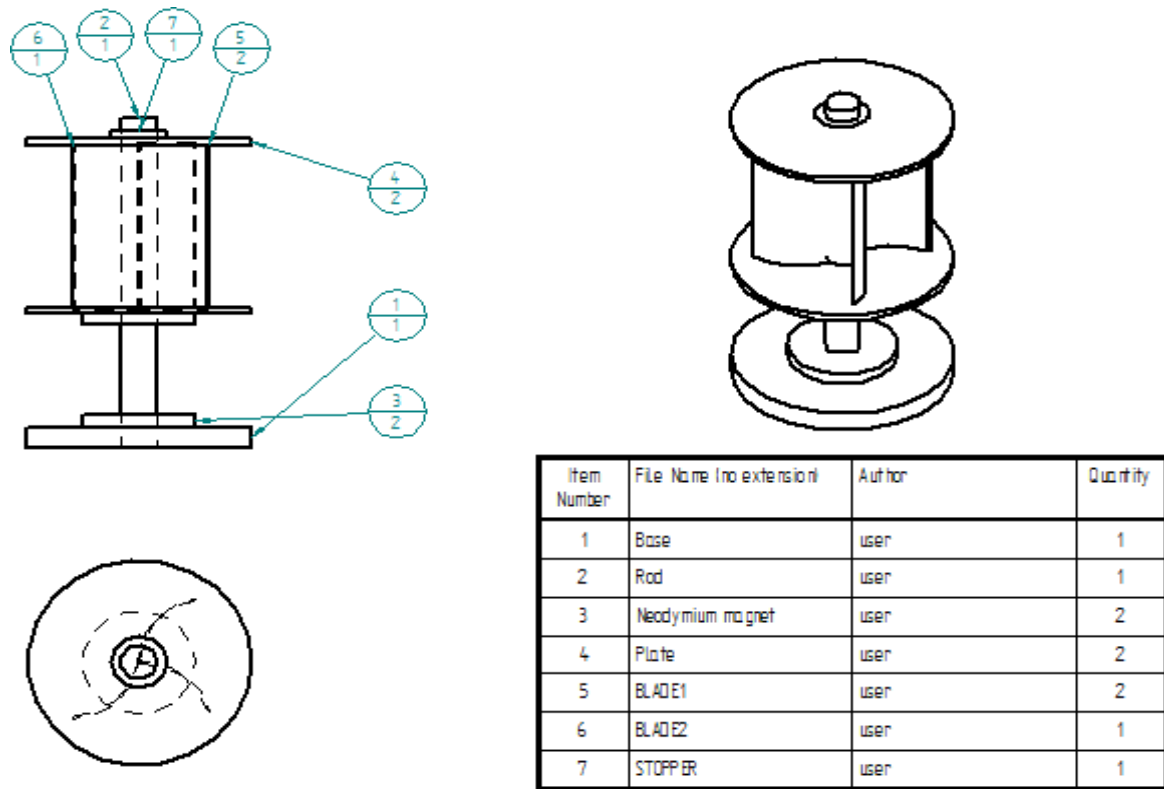


Fig. 3. Parts label of maglev wind turbine, 2D drawing



Fig.4. Isometric view of maglev wind turbine, 3D drawing

Parts used in Maglev Turbine

1. Fixed Pole



Fig.5. Fixed pole

This part is made up of mild steel and it is cylindrical rod like structure. This is mounted on the base perpendicularly, and to which rotor plates and blades are attached to it. Nd- Fe-B magnets are suspended on this pole which gives magnetic cushioning to the rotor component

Dimensions: Diameter - 12mm Height - 800 mm

2. Neodymium Magnets

It is a permanent magnet. It is also called Nd-Fe-B magnets. Two types of magnets are necessary, one is circular in shape and another is ring in shape. Ring shape magnets are used in suspension and circular shape magnets are used for power generation. Ring shape magnets have 25 mm outer diameter and 12mm inner diameter and 6mm thickness.

Circular shape magnets have 18mm diameter and 2mm thickness.



Fig. 6 Ring shape and Circular shape neodymium magnet

3. Rotor Plates

This is made up of acrylic sheet. It is also circular in shape and it is placed above the suspension magnet and blades are clamped to it. Acrylic sheet is used here because of its transparency nature; therefore magnets can be seen clearly as the magnets are attached at the base of the rotor plates both for the cushioning and power generation purpose.

Dimensions: Diameter - 350mm,
Thickness - 6 mm

4. Rotor Blades

This is made up of mild steel pressed into sheet metal. Four blades are used in this

model. These are clamped to the rotor base. Blades are cut in rectangular shape.

Figure 8

Dimensions: Width - 170mm, Height - 620mm, Thickness - 0.5 mm

5. Fixed Base

Base is made up of mild steel. It is circular in shape. This is the area where whole mass is supported, if this is stable and strong the entire model will be in balance. Weight of the base is bit high compared to other parts. See Figure 9

Dimensions: Diameter - 400 mm,
Thickness - 4 mm



Fig. 7 Acrylic Circular Sheet



Fig. 8 Rotor Blades



Fig.9 Base

6. Copper Coil



Fig.10 Copper coils

An uninsulated copper wire is wound in circular shape. A 24-gauge wire is used in our project. 100 number of turns and 7 coils are connected in series to generate electricity.

Field Test:

After the fabrication, the model was taken to conduct the experiments at the outdoor. The experiments are as follows,

Experiment 1

- The first experiment is to check the voltage, mV for different wind speed, m/s and to tabulate those readings.

Table 1 Experiment 1

Sl no	Wind speed, m/s	Voltage, mV
1.	2.778	5.5
2.	5.55	7.8
3.	8.33	9.2
4.	11.11	12.1

The graph for the above readings is plotted below as shown in the below figure where the voltage is plotted in Y-axis and Wind speed in X-axis.

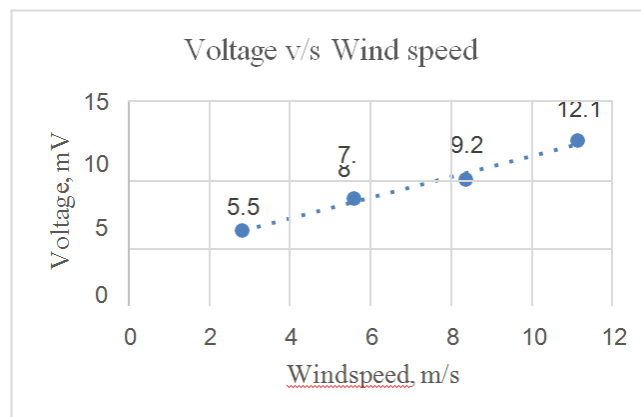


Fig.11 Graphical representation of Voltage vs Wind Speed

Experiment 2

The second experiment is to check the value of current and to tabulate those readings as shown in the below,

Table 2 Experiment 2

Sl no	Wind speed, m/s	Current, mA
1.	2.778	0.09
2.	5.55	0.12
3.	8.33	0.16
4.	11.11	0.19

The graph for the above readings is plotted below as shown in the below figure where the Current is plotted in Y-axis and Wind speed in X-axis.

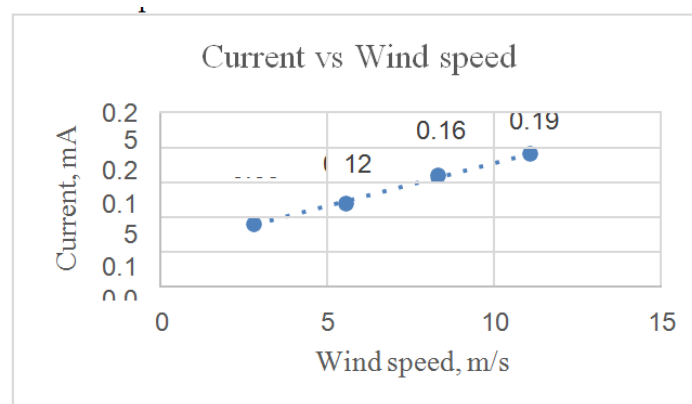


Fig.12 Graphical representation of Current vs Wind Speed

Power Calculation:

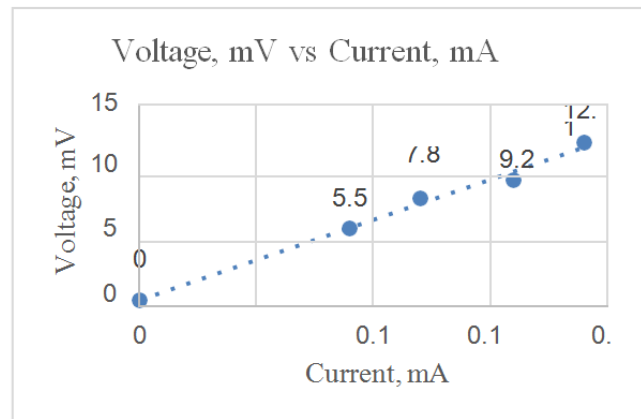


Fig. 13 Graphical representation of Voltage vs Current

To calculate power, first we need to plot a graph of voltage vs current along Y-axis and X-axis respectively.

The graph for Voltage vs Current is as shown above,

We know that generally,

$$\text{Power } P = V \cdot I$$

Where,

P is the power, V is the voltage in mV, I is the current in mA.

From the graph, take $V = 5.5 \text{ mV}$ and $I = 0.09 \text{ mA}$

$$P = 5.5 \times 10^{-3} \times (0.09 \times 10^{-3})$$

$$P = 0.495 \times 10^{-6} \text{ watts}$$

CONCLUSION

Magnetic levitation was used to create a vertical axis wind turbine that performed well. When compared to ordinary horizontal wind turbines, a single large-

capacity maglev wind turbine produces more energy. The efficiency of the turbine is increased by the use of magnets, which allow the turbine to spin at a high speed with less friction by cancelling out the load on the shaft. In comparison to traditional wind turbines, this new design produces more electricity with a greater efficiency. The shaft was employed to prevent the rotor from vibrating. A normal wind turbine with a group of 1000 turbines can power 5 lakh households, but a single maglev wind turbine can power 7.5 lakh homes. A single maglev windmill requires less than 100 acres of land, however a field of 1000 windmills requires more than 64000 acres. We may conclude that a single maglev wind turbine is more cost effective than a conventional wind turbine based on this fact.

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