

Electricity Generation by Maglev Windmill

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Abstract - Human try to develop a system which work at low power from long year and he develop a system Maglev Windmill. There are tremendous advantages of Maglev Motion (Magnetic Levitation) in a Maglev Train it is fast move also it has needed low power. If this system is use in a Windmill then by this size of blade is decrease more power is obtain and work at low wind power. It is possible to use it is as a decorative piece. Here two magnets of same pole place opposite to each other. Bushing is use to decrease friction. Plastic fan blade is use for convert air pressure in to mechanical energy. Whole structure is mounted on the base plate. Here 4 round shape magnets are used as a self-power 2 coils are used to generate electrical energy. Here 12 volt rechargeable battery is used to store electrical energy and provide to circuit. LED lamp is use for convert electrical energy in to light energy. Due to low friction motion is obtain at low power and for long time

Keywords: Maglev Windmill, Magnetic Levitation, Maglev Train, Windmill, Magnets, Bushing.

1. INTRODUCTION

1.1 General

Renewable energy is generally electricity supplied from sources, such as wind power, solar power, geothermal energy, hydropower and various forms of biomass. The aim of this major qualifying project is to design and implement a magnetically levitated vertical axis wind turbine system that has the ability to operate in both high and low wind speed conditions. Our choice for this model is to showcase its efficiency in varying wind conditions as compared to the traditional horizontal axis wind turbine. This levitation will be used between the rotating shaft of the turbine blades and the base of the whole wind turbine system. The conceptual design also entails the usage of spiral shaped blades and with continuing effective research into the functioning of sails in varying wind speeds and other factors, an efficient shape and size will be determined for a suitable turbine blade for the project.

The arrangement of the magnets will cultivate an effective magnetic field and the copper coils will facilitate voltage capture due to the changing magnetic field. The varying 2 output voltage obtained at this juncture will then be passed through a DC-DC converter to achieve a steady output DC voltage.

1.2 Wind Power Technology and Its Need

The popularity of renewable energy has experienced a significant upsurge in recent times due to the exhaustion of conventional power generation methods and increasing realization of its adverse effects on the environment. It is estimated that renewable sources might contribute about 20%-50%. Maglev wind turbines have several advantages over conventional wind turbines. For instance, they're able to use winds with starting speeds as low as 1.5 meters per second (m/s). Also, they could operate in winds exceeding 40 m/s. It would also increase generation capacity by 20% over conventional wind turbines and decrease operational costs by 50%. This makes the efficiency of the system higher than conventional wind turbine.

2. LITERATURE REVIEW

Wind is a natural power source that can be economically used to generate electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for specific tasks or a generator can convert this mechanical power into electricity. Its main advantages are that it uses frictionless bearings and a magnetic levitation design and it does not need to vast spaces required by more conventional wind turbines. It also requires little if any maintenance. Magnetic levitation is supposedly an extremely efficient system for wind energy. [1]

India is the 5th largest wind energy producer globally after China, US, Germany, and Spain. Wind has made a significant contribution to the installed capacity of power generation and has emerged as a competitive option to fossil fuel based power generation. This is due to the multidimensional initiatives taken by the Ministry of New and Renewable Energy (MNRE) through the Wind Power Program, which aims at large scale commercialization of cost effective generation of grid quality wind power. [2]

India's current renewable energy contribution stands at 44.812 GW which includes 27.441 GW of Wind power and 8.062 GW of Solar power installed capacity in the country (As on 31.07.2016). We believe in "GO GREEN" theory. So we are trying to implement a new vertical axis wind turbine by using magnetic levitation. This paper represents maglev windmill concept. The main concept is magnetic levitation. These concepts introduced in

windmill for maximization of the energy production & reduced friction. [3]

Magnetic levitation is a method by which an object is suspended with no support other than magnetic fields. The principal advantage of a maglev windmill from a conventional one is, as the rotor is floating in the air due to levitation, mechanical friction is totally eliminated. That makes the rotation possible in very low wind speeds, which is the new direction to improve the performance of wind turbines. [4]

The wind power has been harnessed by mankind for a long time and the associated technology is more advanced than other clean energies. There are two types of wind turbines, namely horizontal-axis wind turbine (HAWT) and Vertical-axis wind turbine (VAWT). The latter has many advantages, such as low cost, simple-structured blades, convenient installation and maintenance, and the ability to utilize wind from all directions without the need of a steering mechanism. [5]

3. TYPES OF WIND TURBINES

Many types of turbines exist today and their designs are usually inclined towards one of the two categories:

1. Horizontal-axis wind turbines (HAWTs)

2. Vertical-axis wind turbines (VAWTs)

As the name pertains, each turbine is distinguished by the orientation of their rotor shafts. The former is the more conventional and common type everyone has come to know, while the latter due to its seldom usage and exploitation, is quiet unpopular.

The HAWTs usually consist of two or three propeller-like blades attached to a horizontal and mounted on bearings the top of a support tower.

When the wind blows, the blades of the turbine are set in motion which drives a generator that produces AC electricity. For optimal efficiency, these horizontal turbines are usually made to point into the wind with the aid of a sensor and servo motor or a wind vane for smaller wind turbine applications.

With the vertical axis wind turbines, the concept behind their operation is similar to that of the horizontal designs.

The major difference is the orientation of the rotors and generator which are all vertically arranged and usually on a shaft for support and stability. This also results in a different response of the turbine blades to the wind in relation to that of the horizontal configurations.

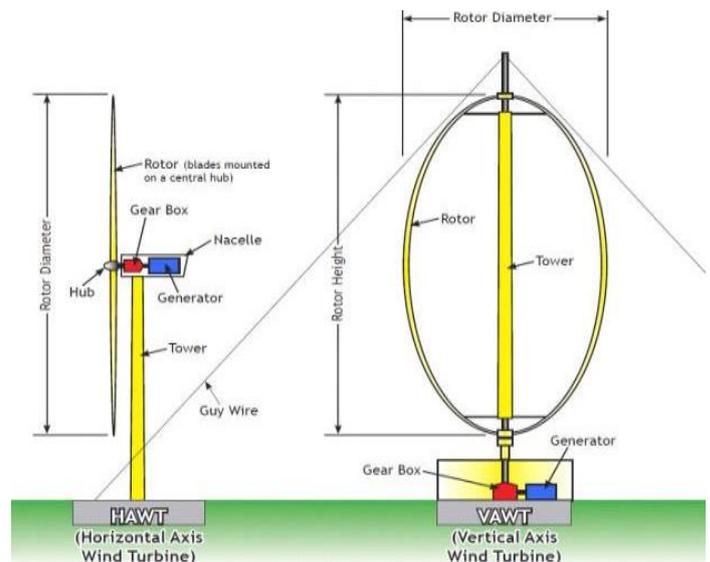


Fig - 1: HAWT and VAWT

Their design makes it possible for them to utilize the wind power from every direction unlike THE HAWTs that depend on lift forces from the wind similar to the lift off concept of an airplane. Vertical axis wind turbines are further subdivided into two major types namely the Darrieus model and the Savonius model. Pictured above in figure is an example of the Darrieus Model which was named after designer and French aeronautical engineer, Georges Darrieus. This form of this design is best described as an eggbeater with the 9 blades, two or three of them bent into a c-shape on the shaft.

4. ADVANTAGES OF VERTICAL AXIS TURBINE OVER HORIZONTAL AXIS TURBINE

Horizontal axis wind turbine dominate the majority of the wind industry. Horizontal axis means the rotating axis of the wind turbine is horizontal, or parallel with the ground. In big wind application, horizontal axis wind turbines are almost all you will ever see. However, in small wind and residential wind applications, vertical axis turbines have their place. The advantage of horizontal wind is that it is able to produce more electricity from a given amount of wind. So if you are trying to produce as much wind as possible at all times, horizontal axis is likely the choice for you. The disadvantage of horizontal axis however is that it is generally heavier and it does not produce well in turbulent winds.

In comes the vertical axis wind turbine. With vertical axis wind turbines the rotational axis of the turbine stands vertical or perpendicular to the ground. As mentioned above, vertical axis turbines are primarily used in small wind projects and residential applications. Vertical-Axis-Wind-Turbine this niche comes from the OEM's claims of a vertical axis turbines ability to produce well in tumultuous wind conditions. Vertical axis turbines are powered by wind coming from all 360 degrees, and

even some turbines are powered when the wind blows from top to bottom. Because of this versatility, vertical axis wind turbines are thought to be ideal for installations where wind conditions are not consistent or due to public ordinances the turbine cannot be placed high enough to benefit from steady wind.

5. MAJOR COMPONENTS OF WIND TURBINE

A wind turbine basically draws the kinetic energy from the wind and converts this power to electrical energy by means of a generator. Its operability is dependent on key components of the turbine and its response to the wind based on how it is built.

All these components sit on a tower usually made out of steel or concrete. The height of the tower is dependent on the size of the rotors and the desired amount of electricity generation. Taller towers serve as an advantage because wind speed is abundant with height so the rotors will work well with increased tower height and promote more and efficient electricity generation. All major components in wind turbine (vertical axis wind turbine and horizontal axis wind turbine) are below.

1.Tower 2.Rotor Blade 3.Rotor Hub 4.Rotor Bearing 5.Main shaft 6.Gear Box 7.Generator 8.Pitch System 9.Power Converter 10.Transformer 11.Brake System 12.Permanent Magnet 13.Electric Battery 14.Electromagnetic Coil

6. DESIGN AND CONSTRUCTION

The whole structure project is situated on fixed based (usually plywood is used). Permanent magnet is fixed at the bottom surface of vertical axis wind turbine and also on the above surface of fixed base. Coils are also fixed. As the blades rotates shaft rotates itself and electricity generated and generated electricity is stored in battery.

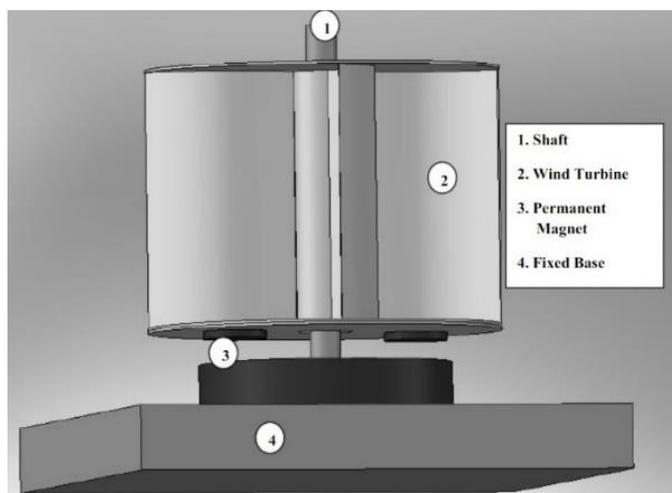


Fig -2: Model of Maglev Windmill

Permanent magnets are magnets that are permanently charged. They are different from electro-magnets in that electro-magnets only have magnetic properties when an electrical current is flowing through them. While care must be taken when handling and using permanent magnets.

The basic understanding of a generator is that it converts mechanical energy to electrical energy. Generators are utilized extensively in various applications and for the most part have similarities that exist between these applications.

An electromagnetic coil is an electrical conductor such as a wire in the shape of a coil, spiral or helix. Either an electric current is passed through the wire of the coil to generate a magnetic field, or conversely an external time-varying magnetic field through the interior of the coil generates an EMF (voltage) in the conductor.

Magnetic Levitation operates on the repulsion characteristics of permanent magnets. Using a pair of permanent magnets and substantial support magnetic levitation can easily be experienced. By placing 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.

AC is popular because the voltage can be easily stepped up or down using a transformer. Due to the inherent properties of a transformer, DC voltage cannot be altered using this type of equipment. Direct current cannot provide a changing magnetic field therefore a transformer with an applied DC input would only produce heat. The output from the maglev windmill will be an alternating voltage. This output can be directly connected to a load or can be converted to dc and stored in a battery for later use.

7. PRINCIPLE

The basic working principle of a wind turbine is when air moves quickly, in the form of wind, the kinetic energy is captured by the turbine blades. The blades start to rotate and spin a shaft that leads from the hub of the rotor to a generator and produce electricity. The high speed shaft drives the generator to produce electricity. The low speed shaft of wind turbine is connected to shaft of high speed drives through gears to increase their rotational speed during operation. Using the effects of magnetic repulsion, spiral shaped wind turbine blades will be fitted on a rod for stability during rotation and suspended on magnets as a replacement for ball bearings which are normally used on conventional wind turbines. The energy that can be extracted from the wind is directly proportional to the cube of the wind speed. We

can then calculate the power converted from the wind into rotational energy in the turbine using equation.

$$P_{avail} = 0.5\rho Av^3C_p$$

Where,

P avail = output power available in watts.

ρ = density of air in kg/m³

A = area swept by blades.

V = Velocity of Wind

C_p = the power coefficient called Bets limit

C_p max = 0.59

8. WORKING

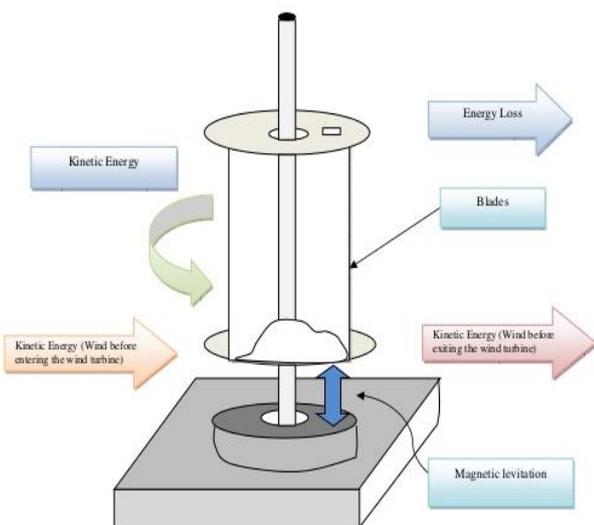


Fig - 3: Working

Above figure gives an idea of MAGLEVE WIND TURBINE. This phenomenon operates on the repulsion characteristics of permanent magnets. Using a pair of permanent 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. Power will then be generated with an axial flux generator, which incorporates the use of permanent magnets and a set of coils. The generated power is in form of DC, stored in battery, this can be used to directly supply the DC loads and can also be converted to AC using inverter to supply AC loads. This

technology eliminates nearly all friction and delivers maximum wind energy to the downstream linear generator.

$$P_w = \frac{1}{2}MAu^3 \dots\dots\dots (1)$$

Where,

P_w: Power of the wind (W)

M: Air density (kg/m³)

A: Area of a segment of the wind being considered (m²)

u: Undisturbed wind speed (m/s)

$$P_m = \frac{1}{2}M\left(\frac{16}{27}Au^3\right) \dots\dots\dots (2)$$

Where,

P_m; Mechanical power (W)

The constant $\frac{16}{27} = 0.593$ from equation (2) is

Referred to as the Betz coefficient. The Betz coefficient tells us that 59.3% of the power in the wind can be extracted in the case of an ideal turbine.

For a VAWT, this area depends on both the turbine diameter and turbine blade length.

$$A_s = D_t l_b \dots\dots\dots (3)$$

Where,

A_s: Swept area (m²)

D_t: Diameter of turbine (m)

l_b: Length of the turbine blades (m)

9. CIRCUIT DIAGRAM

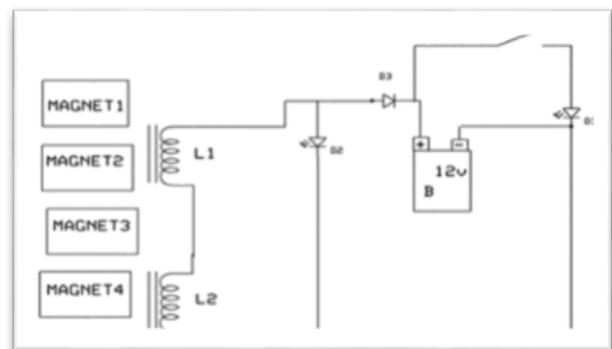


Fig - 4: Circuit Diagram

According to Faradays Law of electromagnetic induction, whenever a conductor is placed in a varying magnetic field (or a conductor is move in magnetic field), an EMF (Electromotive

Force) gets induced in conductor, there are stand still coil and moving magnet so current is produced. Then AC converted into DC by D3. D2 is LED which signed that current is produced. Then stored in battery.

10. BLOCK DIAGRAM

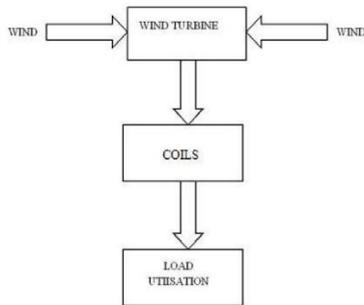


Fig – 5: Block Diagram

Wind turbine transforms kinetic energy into power. The process begins when wind contacts with turbine blades and transforms kinetic energy to power. The main shaft rotates as well as creating mechanism.

Main shaft is connected to the gear box which rotates parallel shaft at about 30 times the rate of main shaft.

In generator magnets are arrange surrounding a coil. The shaft connects to the magnet assembly spinning it around the stationary coil of wire and creating voltage in wire.

11. FUTURE SCOPE

MagLev was first unveiled in the Wind Power Exhibition in Asia in Beijing. This turbine is surely going to take wind power technology to a whole new level with the help of magnetic levitation. The turbine has vertically oriented blades and these are suspended in the air above the base of the machine. Hence there is no use of ball bearings to support the blades. The turbines make use of permanent magnets instead of electromagnets. Hence there is no use of electricity to run the turbines. The magnet employs the practicality of neodymium magnets and hence there is no energy wasted in terms of friction. Hence there are no maintenance costs to be shelled out and the life of the generator is increased manifold. MagLev is able to make use of low intensity winds that blow at 1.5 meters per second. And the turbine can also operate well in high intensity winds of 40 m/s. Today one MagLev can produce total power of one gigawatt of power which is enough to provide electricity to 750,000 homes.

Hence you can imagine how important a MagLev can be to produce clean and green electricity to sustain our environment. The MagLev has also increased wind generation capacity by 20% over the conventional wind turbines. The operational costs on the other hand have decreased by 50%. The wind turbines will be made

operational for at least the next 500 years. Construction of the MagLev was started in China in November, 2007.

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CONCLUSION

After testing the project as an overall system we found that it functioned properly but there are many things that can be improved upon. The generator itself had some design flaws which we feel limited the amount of power it could output. These flaws start at the coils which were initially made too thick and limited how close the magnets attached to the stator could be positioned from each other. If the magnets were pulled in closer to one another, the magnetic field density would be much greater allowing for more power to be inducted into the coils. Another setback was that the wire that was used to wrap the coils was 30 AWG and because of its small cross section it restricted the amount of current that could be drawn from the generator. Lastly, the plexus-glass that was used for the frame of the wind turbine was too elastic. Due to the fact it was not as strong as we had hoped, there was some sag in frame about the central axis where the majority of the weight and force was located. If a more heavy duty material was used in future design then it would allow for more precision in magnet placement.

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