International Journal of Latest Research in Engineering and Technology (IJLRET)
ISSN: 2454-5031
www.ijlret.com ǁ PP. 169-174

MAGNETICALLY LEVITATED VERTICAL AXIS WIND TURBINE WITH INVERTER DESIGN

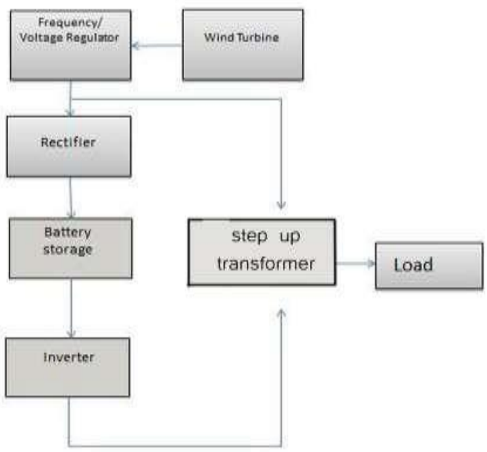
Manjunatha Babu P, Sagar, Pavan Kumar C R, Sharath Chandra V C, Praveen Kumar

8th Semester students, Department of Electrical and Electronics Engineering,
BMS Institute of Technology and Management
Yelahanka Bangalore-560064

ABSTRACT: This paper dwells on the implementation of an alternate configuration of a wind turbine for power generation purposes. 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. Power will then be generated with an axial flux generator, which incorporates the use of permanent magnets and a set of coils. The aim of this paper 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 conditions. This new model of wind turbine uses magnetic levitation to reduce the internal friction of the rotor which is considered as a revolution in the field of wind technology, producing 20% 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. Our 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 paper is to harness wind energy in more efficient way with frictionless magnetic levitated operation.

1. INTRODUCTION

Unlike the traditional horizontal axis wind turbine, this design is levitated via maglev (magnetic levitation) vertically on a rotor shaft. This maglev technology, which will be looked at in great detail, serves as an efficient replacement for ball bearings used on the conventional wind turbine and is usually implemented with permanent magnets. 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 ofsails in varying wind speeds and other factors, an efficient shape and



size will be determined for a suitable turbine blade. With the appropriate mechanisms in place, we expect to harness enough wind for power generation by way of an axial flux generator built from permanent magnets and copper coils. 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.

1.2WIND TURBINE DESIGN

In the designed prototype, the stator and rotor are separated in the air using the principle of magnetic levitation.

The rotor is lifted by a certain centimetres in the air by the magnetic pull forces created by the ring type Neodymium magnets. This is the principal advantage of a maglev windmill from a conventional one. That 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. **Fig-1** illustrates the magnetic levitation in our prototype.

Fig-1 Levitation between stator and rotor

The blades used in this prototype are not of the conventional type. In this prototype we have use aluminium of diameter 185 mm. The height of aluminium blade is 800mm **Fig- 2** shows blade design.

Fig-2 Blade Design

III. Final model:

The overall structure of the prototype designed is shown in the **figure 3**. The output voltage obtained from this prototype is measured using a millimetre and a maximum of 40 volts AC were obtained.

Fig-3 final design

IV. Coil design:

The number of windings per coil produces a design challenge. The more win dings will increase the voltage produced by each coil but in turn it will also increase the size of each coil. In order to reduce the size of each coil a wire with a greater size gage can be utilized. Again another challenge is presented, the smaller the wire becomes the less current will flow before the wire begins to heat up due to the increased resistance of a small wire. Each one of our coils has a measured resistance of 40-Ω; a smaller gage wire would further reduce this resistance.

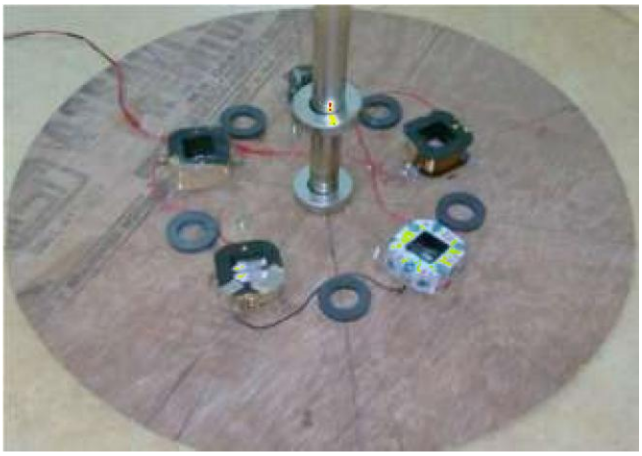


Fig 4 coil design

Although design seems like Twisted it basically holds principle of savanious model

2. EQUATIONS

2.1 Wind blade design equations:

$$\text{Kinetic Energy} = \frac{1}{2} MV^2 \quad \text{.................eq. 1}$$

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

M = ρAV

Substituting the value of M in eq. 1 we get:

To convert the energy to kilowatts a non-dimensional proportionality

$$\text{Kinetic Energy} = \frac{1}{2} (\rho AV)V^2$$

$$\text{Kinetic Energy} = \frac{1}{2} \rho AV^3$$

constant k =2.14*10^-3is introduced.

Power in KW (P) = $2.14\rho AV^3\, 10^{-3}$

2.2 COIL DESIGN

Finding Field Density (B)

Now we move to another more useful graph the magneto motive force measured in Amperes versus the flux measured in Weber.First we have to find the surface area of our magnets.

Area=$\frac{\pi}{4} D^2$

$= \frac{\pi}{4} (0.01)^2$

$=7.8540\times 10^{-5} m^2$

The length (l) or height of the magnets is given

L=0.01m

Given these values we can calculate the magneto motive force

HL=875× 10^3 ×0.01

=8750A

The flux is also calculated using the field density and magnet area.

$\phi = BAcos\theta$

$=2 \times 7.8540 \times 10^{-5}$

$\phi = 1.5708 \times 10^{-4}$weber

In order to find the true value of the field density between to magnets we must calculate the reluctance of the air gap.

If the generator is rotating at velocity (v) 0.63m/s or 50 rev/min the change in time is calculated below using the radius (r) of a coil.

dt=$\frac{1}{v} \times r$

$= \frac{1}{0.63} \times 0.0191$

=0.03sec

From these values we can now calculate the maximum voltage given 2000 turns (N) per coil.

$V = N\frac{d\phi}{dt}$

$= 2000 \times \frac{5.9 \times 10^{-4}}{0.03}$ =39.3333v

3. ENERGY HARVESTING SYSTEM:

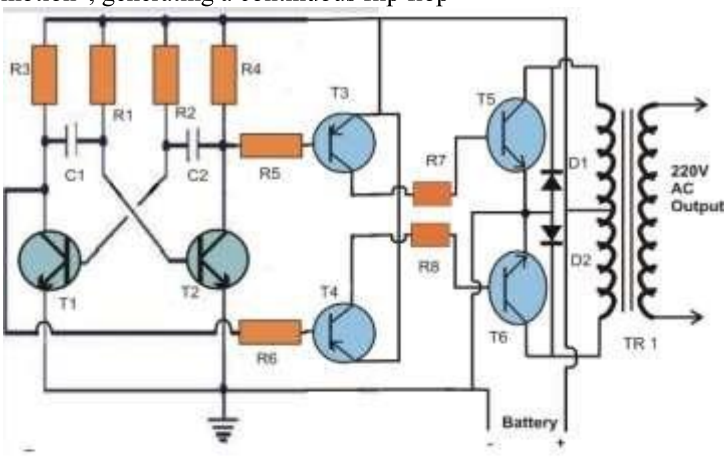
After the wind turbine design during testing small amount of flickering was observed this is due to the frequency variations. To eliminate this problem the AC voltage obtained from the wind turbine is converted to DC voltage using commercially available bridge rectifier.

The obtained DC is inverted back using this inverter. As our wind turbine is of low power rating instead of power inverter we designed less powered inverter typically 50w inverter.

A 50 watt inverter might look quite trivial, but it can serve some useful purposes to you. When outdoors, this small powerhouse can be used for operating small electronic gadgetssoldering iron, table top radios, incandescent lights, fans etc

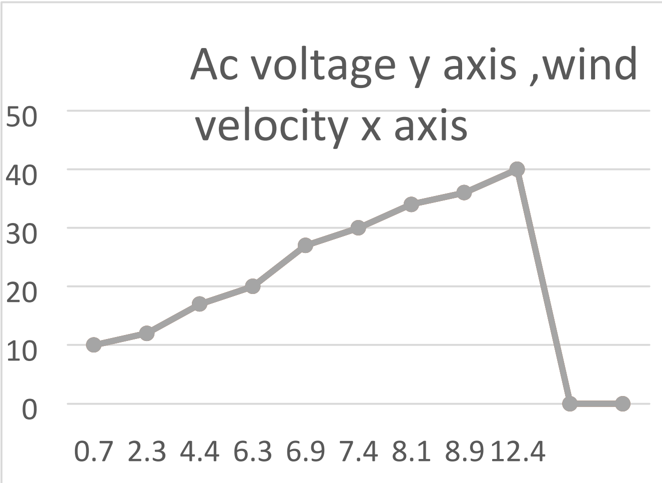
4. Circuit Descrip*tion:*

The circuit may be understood with the following points: transistors T1 and T2 along with the other R1, R2, R3 R4, C1 and C2 together form a simple astable multivibrator (AMV) circuit. A multivibrator circuit basically is composed of two symmetrical half stages, here it's formed by the left and the right hand side transistor stages which conduct in tandem or in simple words the left and the right stages conduct alternately in a kind of a perpetual "motion", generating a continuous flip flop



action. The above action is responsible of creating the required oscillations for inverter circuit. The frequency of the oscillation is directly proportional to the values of the capacitors or/and the resistors at the base of each transistor. Lowering the values of the capacitors increases the frequency while increasing the values of the resistors decreases the frequency and vice versa. Here the values are chosen so as to produce a stable frequency of 50 Hz. Transistors T2 and T3 are placed at the two output arms of the AMV circuit. These are high gain; high current Darlington paired transistors, used as the output devices for the present configuration.

The frequency from the AMV is fed to the base of T2 and T3 alternately which in turn switch the transformer secondary winding, dumping the entire battery power in the transformer winding. The required main voltage at the output of the transformer.



5. CONCLUSION

The output voltage obtained from this prototype is measured using millimetre and a maximum of 40 V AC was obtained. 42 guage wire of 2000 turn each are used as coils for power generation. 5 set of such coils are used in the prototype. On increasing number of turns, output voltage can be increased.

Wind velocity (m/s)	Ac Voltage (rms) in volts
0.7	10
2.3	12
4.4	17
6.3	20
6.9	27
7.4	30
8.1	34
8.9	36
12.4	40

REFERENCES

[1]. Erich Hau “Wind Turbines: Fundamentals, Technologies, Application, Economics” Springer Publishers, 2005.

[2]. C Strojan“Environmental and Aesthetic Assessment of Small Wind EnergySystems” Paperback Publishers, 1985.

[3]. Paul Gipe “Wind Energy Comes of Age (Wiley Series in SustainableDesign)”,Hardcover Publishers,1995.

[4]. Thomas E Kissell “Introduction to Wind principles”, Pearson education, 2002.

[5]. Z. Zhang, A. Verma, and A. Kusiak, “Fault Analysis of the Wind Turbine Gearbox”, IEEE Transactions on Energy Conversion, Vol. 27, No. 2, 2012, pp. 526-535 [Wind energy].

[6]. A. Kusiak and A. Verma, “A Data-Mining Approach to Monitoring Wind Turbines”, IEEE Transactions on Sustainable Energy, Vol. 3, No.1, 2012, pp. 150-157 [Wind energy].

[7]. A. Kusiak and A. Verma, “A Data-driven Approach for Monitoring Blade Pitch Faults in Wind Turbines”, IEEE Transactions on Sustainable Energy, Vol. 2, No.1, 2011, pp. 87-96 [Wind energy].

[8]. A. Kusiak and Z. Zhang, Adaptive Control of a Wind Turbine with Data Mining and Swarm Intelligence, IEEE Transactions on Sustainable Energy, Vol. 2, No. 1, 2011, pp. 28-36 [Wind energy].

[9]. A. Kusiak and W.Y. Li, The Prediction and Diagnosis of Wind Turbine Faults, IEEE Transactions on Renewable Energy, Vol. 36, No. 1, 2011, pp. 16-23 [Wind energy].
[10]. A. Kusiak and Z. Zhang, Short-Horizon Prediction of Wind Power: A Data Driven Approach, IEEE Transactions on Energy Conversion, Vol. 25, No. 4, 2010, pp. 1112-1122 [Wind energy].
[11]. A. Kusiak, Z. Zhang, and M.Y. Li, Optimization of Wind Turbine Performance with Data-Driven Models, IEEE Transactions on Sustainable Energy, Vol. 1, No. 2, 2010, pp. 66-76 [Wind energy].

AUTHORS:

Sharath Chandra V C
Email:vcsharath9@gmail.com
Student ,Completed 8TH SEM B.E
sem Area of interest: Power electronics, Control Systems etc
Electrical and Electronics, Engineering
BMS Institute Of Technology.

Pavan kumar C R
Email:Pavankumarcr3@gmail.com Student
,Completed 8TH SEM B.E
Area of interest: Power systems, Renewable energy etc Electrical and
Electronics, Engineering
BMS Institute Of Technology.

Praveen N
Email:Praveenn200@gmail.com
Student ,Completed 8 TH SEM B.E

SAGAR R
sagarmly3@gmail.com
student ,completed 8th
BMSIT