

Electricity Generation Using Wind Belt Technology

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Abstract - The awareness toward generations of electrical energy from the renewable energy. Source is increasing day by day. Some of the innovations have very bright future. These innovative equipment can be proven as prospective weapons against today's energy crisis in electrical generation. Wind is one of the best alternatives among renewable source. Wind belt is the device which converts the mechanical vibration into electrical energy at expense of kinetic energy of wind. According to the name the wind belt consist of a belt i.e. aero elastic flutter which will vibrate due to air flow. Due to the movement of belt, the magnets attach to the belt will vibrate in between the copper coil so as to generate emf. Basically the electricity generation using wind belt technology based on the aerodynamic phenomenon aero elastic flutter, the electromagnetic induction and uses some electronic component such as rectifier for converting AC into DC. In this paper we are going to focus on the conversion of energy of wave into electrical energy.

Key Words: Flutter, Wind energy, Electrical energy, Wind belt.

1. INTRODUCTION

The paper discuss the currently investigated innovative technique to generate electrical energy to overcome the today's challenge the idea of generating electrical energy from the Tacoma narrow bridge who was only 4 month old when it collapsed due to strong wind in 1940. The amount of energy required causing enormous amount of steel & concrete to more & eventually collapse huge bridge can vibrate then why not a belt and the concept of generating electrical energy from belt vibrate comes into light. It is in the practice from the long the time to use the wind. The wind belt is the best alternative to the wind turbine. We aim to settle into renewable energy based future, so the reliance on the fossil fuel must be the minimized in order to keep with progressin.so, th

e wind belt technology help to reduce the reliance on fossil fuel. Wind belt technology is new and these vast scope for the advancement. The purpose of this initiative is to combine fluid mechanic and vibration to create a device that generate electricity from wind energy for the development countries without access the power grid and in need of low cost power

generation, wind belt technology can be proven are more effective solution to fulfill the daily effective needs.

2. CONSTRUCTION

We settled on a conceptual design based around American Engineer Shawn Freyne's Wind-belt. The Wind-belt is a wind based power generator, and it is the only design in its field that doesn't require a turbine. The Wind-belt applies the concepts of aero elastic flutter and electromagnetic induction to harness the renewable energy wind resource and output a low voltage of alternating current.

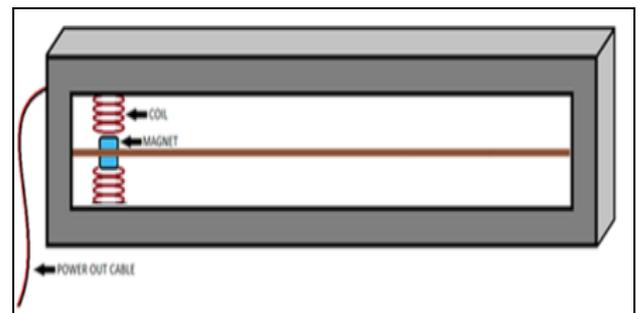


Fig -1: Construction of model

2.1 Component

The Wind-belt is a very simple design that can be self-modified and enhanced to complete the needs of the user. The main components are a containing bracket, eight copper coils bundles, eight strong button neodymium magnets, a ribbon and taffon belt it's having higher elastic property.

1) Bracket (Frame)

The bracket holds together the entire unit. It can be fabricated from any available material such as treated timber, aluminium or plastic. The bracket requires a top and bottom piece and four spacer pieces. It is important to consider the lifespan of the material since exposure to the elements is imminent. Weather treatment and protection will need to be applied, or else the Wind-belt can be sheltered in an environment that channels wind through the capture zone.

2) The Ribbon

The ribbon is the platform for the entire functionality of the Wind-belt. When exposed to wind above 3m/s the ribbon in our Wind-belt will experience aero elastic flutter. Wind will cause the ribbon to move up and down with high frequency oscillating motion. It can be pictured to be similar to the flutter of a tarp on the back of a Ute, or the vibration of a piece of grass stretched between your fingers. The material for the ribbon can be anything durable enough to withstand monsoon weather and high wind forces. The company Humdinger has shown that a Mylar coated ribbon will be most durable and lightweight solution. It is key for the ribbon to be as light as possible so that the cut in wind speed for flutter is minimized. The ribbon also needs to be torsional strong so that the oscillation is as linear as possible, with little twist during the motion.

3) Button Magnets pairs

Two button magnets are attached to the ribbon in line with the center of the copper coils. Joining the magnets on either side of the ribbon means they naturally attract, and using strong magnets will prevent movement over time. The stronger the magnetic field, the greater the magnetic flux and thus the larger induced current. As the magnets move up and down with the flutter of the ribbon the polarity of the field through the copper coils reverses. This change in polarity results in an alternating current best represented by the sine wave.

A neodymium magnet (also known as NdFeB, NIB or Neo magnet), the most widely used type of rare-earth magnet, is a permanent magnet made from an alloy of neodymium, iron and boron to form the Nd₂Fe₁₄B tetragonal crystalline structure.

Developed in 1982 by General Motors and Sumitomo Special Metals, neodymium magnets are the strongest type of permanent magnet commercially available. They have replaced other types of magnet in the many applications in modern products that require strong permanent magnets, such as motors in cordless tools, hard disk drives and magnetic fasteners.

3. WORKING PRINCIPLE

The Wind-belt is an innovation which is based around the two main principles of Aero elastic Flutter and Electromagnetic Induction.

1) Principle 1: Aero elastic Flutter

Aero elastic Flutter involves aerodynamic forces acting on a structure to result in a self-feeding high energy oscillation. Flutter has the potential to occur in any object subject to wind. If there is positive feedback in the structure between the aerodynamic forces and its natural vibration, flutter will occur. This means that the vibrational oscillation of the object, coupled with wind, will drive the object to move farther or faster.

2) Principle 2: Electromagnetic Induction

The second principle behind the Wind-belts design is that of Michael Faraday's electromagnetic induction. Electromagnetic induction is the production of voltage across a conductor in a changing magnetic field.

Faraday found and stated that the „induced electromotive force or EMF in any closed circuit is equal to the time rate of change of the magnetic flux through the circuit. Faraday's law is:

$$\varepsilon = -N * \Delta\Phi / \Delta t$$

Where,

N = the number of loops of a conductive coil

$\Delta\Phi$ = the change of electromagnetic flux

In practice, a changing magnetic field applied through a conductive wire in a closed circuit will generate electricity. The current produced in the Wind-belt is an alternating current, with a frequency typically between 20 and 30Hz depending on the wind speed and construction dimensions for the unit.

3) Principle 3: Vibrations due to air flow

Vibrations deal with behavior of bodies under the influence of oscillatory forces. These forces are caused frequently by dynamically unbalanced masses in rotating machines or by the motion of the body itself. Vibrations can be used the way wind, say, we use for making the belt flutter.

In our case, as we are trying to harness energy from vibration, high amplitudes will actually be beneficial. Higher the amplitude, more the belt will flutter, and more will be the output of the system.

4) Use of Torsion Belt for Power Generation

Up till now we have seen that only the bending motion of the belt is utilized for the generation of the electricity and now we will be seeing that how we can use the torsion for the generation of the electricity. The coil wounded on the cylindrical core facilitates only the production of the electricity by using the bending effect. For utilizing the torsion we can think of the arrangement similar to the moving coil galvanometer. In moving coil galvanometer the coil swivel's in the radial magnetic field generated by using the magnets with cylindrically concave poles. The arrangement is as shown in figure.

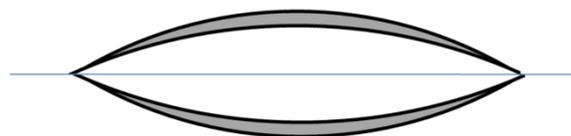


Fig -2: Belt 2D view with torsion

Now if we compare the above arrangement with our wind-belt arrangement one thing is clear that we need radial magnetic field instead of using the magnetic field generated by the button magnets. Following are the various ways discussed how we have obtained electricity using the readily

available magnet in market i.e. button magnets and the cylindrical core coil.

The following is the figure showing the typical setup using the bending effect of belt for the energy generation. The figure indicates two views one view in the direction of wind i.e. parallel and one in perpendicular direction to the wind.

In this first type that we have arranged for the complete swiveling permitted i.e. the magnet will rotate around 180 degrees in one direction first then again back to original position following the reverse direction. The coils are now placed horizontally as considered to typical position discussed while utilizing the bending moment.

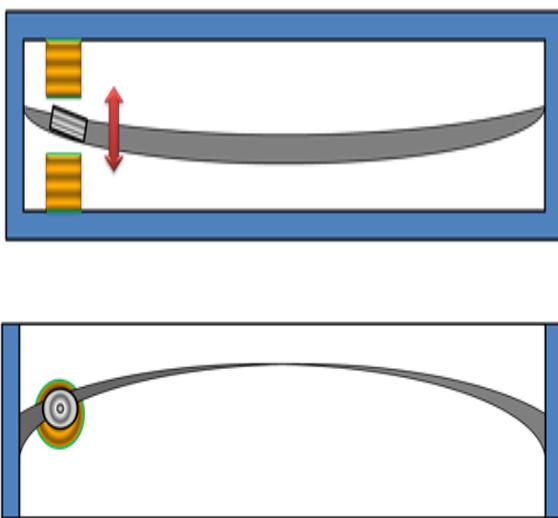


Fig -3: Typical arrangement using bending and oscillation of the magnets about belt axis

3.1 Working of Power Conditioning Circuit

Power conditioning circuit uses the parallel of connection to achieve higher voltages for low wind speed. The circuit uses rectifier, a smoothing capacitor a step up supply and a power storage device such as rechargeable battery or a super capacitor. The function of rectifier is and capacitor is to convert the output of the coils, which is in the form of alternating current, into smooth direct current. The dc current is then fed into the step up supply, or a device storage device is provided to buffer between the current drawn by the application and the supply from the coils of the generator. Therefore there is requirement of diode in the circuit board to control flow of current.

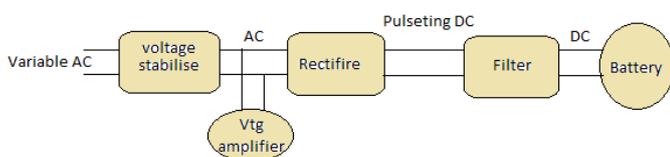


Fig-4: Block diagram of power conditioning circuit

4. RESULT

When we conducted test in parallel connection of two coils on the normal circular permanent magnets and high strength circular magnets that is neodymium magnets and we shall give the wind speed by using the fan.

The wind speed of fan is depending upon the rating of a fan motor.

- 1) We generate the power by using two generator is variable AC voltage and frequency is 20 to 30 Hz.
- 2) The average speed of fan is approximately 4.53 m/s.
- 3) The approximately variable current to be generated forms this model i.e. 4.34 to 8.16 mA.

Table -1: Generated power rating

Sr. no.	Different ratio of speed of fan(in m/s)	Output voltage using permanent magnets	Output voltage using neodymium magnets
1	3 m/s	0.57 V	2.01 V
2	4 m/s	0.75 V	2.42 V
3	5 m/s	1.15 V	2.84 V

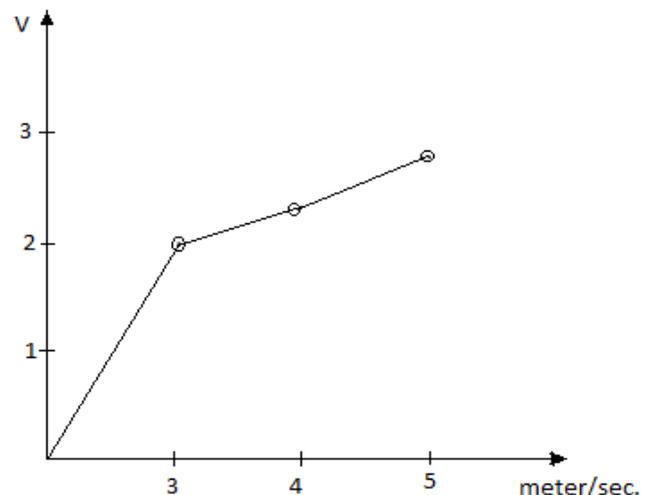


Fig -5: Graph of generated voltage and wind speed

5. CONCLUSION

The Wind belt has no gears or bearings, making it much more efficient than scaled down wind turbines which have to contend with friction. This makes Wind belt preferable for smaller scale applications such as powering LED lights in rural communities. In addition, due to the nature of Aeroelastic flutter, Wind belt can be tuned to optimize their output at different wind speeds and theory is not dependent on high wind speeds. Wind belts are cheap to produce, the

smaller versions costing not more than three to four thousand INR with an expected lifespan of 20 years, and can be easily manufactured in developing countries. Perhaps the most significant barrier to the current use of Wind belt is the relative newness of the technology. Wind belts in any size are not yet being widely manufactured and so each one must be designed and constructed individually. The construction of a wind belt is much simpler to that of a conventional wind turbine. In a wind turbine, gears and other mechanical systems help in moving the turbine and generate electricity, whereas a wind belt is just a very simple mechanism which can be made easily with just few thousand INR. Moreover, wind belt uses even the lightest of the winds for vibrating the membrane. In a recent experiment, a prototype of wind belt was found to be ten to thirty times more efficient than micro turbines. Moreover, as the constructing a wind belt is cheap, it can be an excellent alternative especially in rural areas where kerosene is used for lesser amount of power. As kerosene produces smoke that is known to create health problems, a wind belt seems to be an effective alternative device in the rural areas.

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