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BLADELESS WIND TURBINE

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ABSTRACT: The objective of this project is to build an environmentally friendly wind turbine without any blades. This device will be a new innovative way to harvest wind energy with the use of little materials at a low cost. This will make power with a to and fro movement from the turbine, and the force that will be created will be put away for sometime in the future. The turbine will deliver a lot of force in a short measure of time. In contrast to an ordinary turbine, this one doesn't utilize large equipment from huge motors like a turbine or a rotor. Since this turbine gets its force from motions, it won't interfere with radio waves or with birds flying in its neighborhood.

Index Terms: Bladeless wind turbine, Linear induction (emf) generator, mast, Arc shaped pendulum, Disc shaped pendulum, multidirectional pendulum.

I. INTRODUCTION

Wind power is one of the most readily available sources of renewable energy in nature and is abundantly found in the environment; however, the construction of wind turbine generators itself is costly. This inspired the researchers to design a vortex bladeless wind generator that applies the principle of swaying, through vortex and pendulum movement. Rather than saddling its force from the rotational movement of turbines, it utilizes the pendulum movement brought by vortices to create power. At the point when wind passes one of the round and hollow cylinders, it shears off the downwind side of the chamber in a turning whirlpool or vortex. That vortex at that point applies power on the chamber, making it vibrate, and allows the pendulum to move. The kinetic energy of the oscillating pendulum is converted into electricity, through a linear generator similar to those used to harness wave energy.

II. CONSTRUCTION

1] Construction of a bladeless wind generator prototype and demonstrate its performance on Disc-shaped prototype, Arc-shaped prototype and Multi-directional prototype pendulums,

specifically, it aims to determine the amount of voltage that was harnessed from different wind speeds and select the type of pendulum that can provide better oscillation while inducing unacceptable vibrations.

A] Process flow and construction of prototype

The prototype was first constructed based on the design of the cylindrical shape body where wind will pass through and produce vortex vibration. Cylindrical structure is considered as the best path for vortex vibration; where the wind passes through this body would create a better wind tail swirling to induce enough vortex shedding, to make the chamber waver. The swaying structure is straightforwardly coupled to a pendulum under. This pendulum goes about as central player of a direct generator. While the barrel shaped construction above sways, the pendulum under moves to and fro. An attractive coupling gadget is introduced at the lower part where it fills in as the direct generator. Curls and perpetual magnets are utilized in this part. The deliberate boundaries are arranged as it shifts on the wind speed. The wind speed is measured through an anemometer attached in the vortex bladeless generator.

B] Prototype and its Physical Setup:

The construction of pendulums for vortex bladeless wind generator plays an important consideration of this study as well as the application of Faraday's Law in cutting the maximum flux when pendulum moves sideways across the face area of the coils to induce voltage.

- **Arc pendulum**

Figure 1(a) shows the top view schematic diagram of the arc pendulum where five coil groups are constructed on both sides and the sliding arc shaped pendulum with permanent magnets swings back and forth such that, this magnetic field in the middle is cut through as shown in Figure 1(b). For this type of construction, the cutting of magnetic field is maximized since the arc pendulum covers the entire face area of the coil groups. The stator on the sides of the pendulum is a coil that has 220 turns each. The vortex bladeless wind generator produces induced voltage by cutting the magnetic flux between coils and magnets while swinging.

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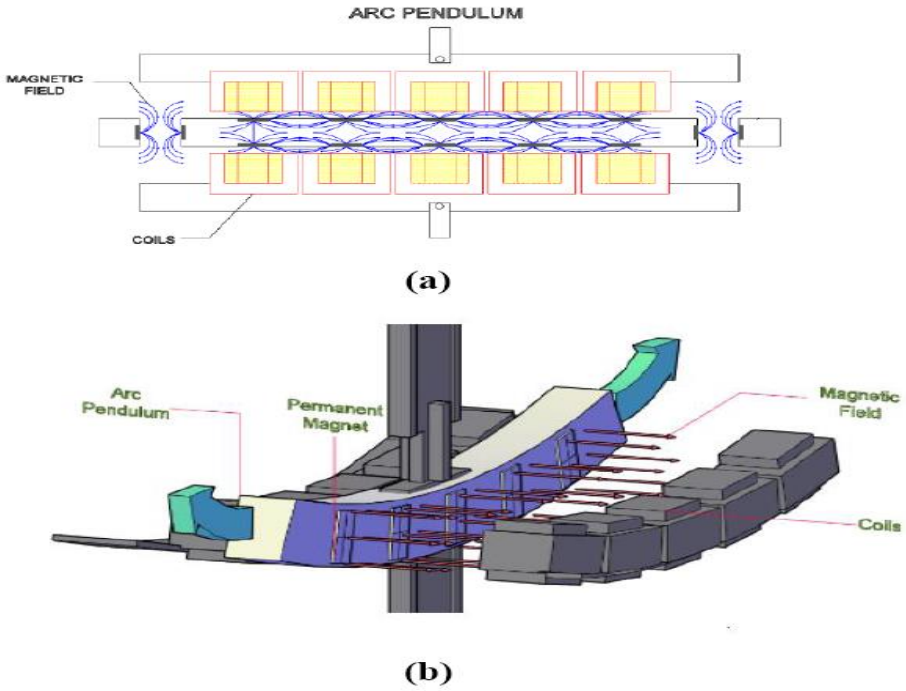

Fig.1: Magnetic Field of Arc Pendulum

Disc pendulum

The other type of pendulum constructed was disc type. However, the limitation was the weight of its body; as such, constructing a bigger disc would cause difficulty in its swinging action but most area under coil face can be covered for higher induced voltage. In line with this observation, a smaller disc size was designed and constructed so it can move freely on that portion of coil group's face area as it swings back and forth as shown in Figure 2(a). However, cutting of flux in this manner is not maximized as compared to the first type shown in Figure 2(b).

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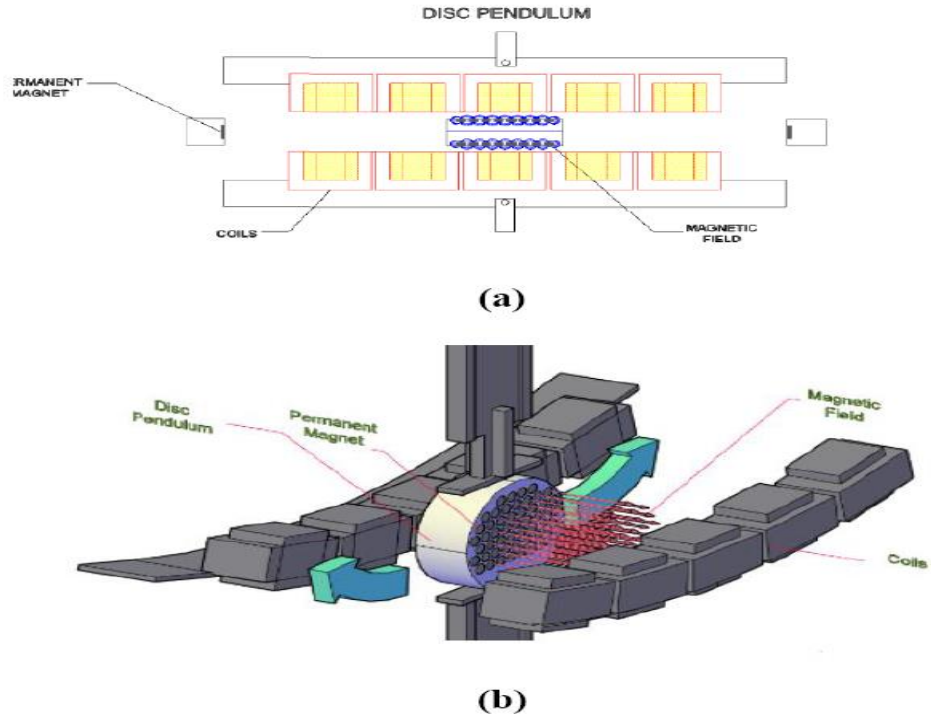

Fig.2: Magnetic Field of Disc Pendulum

Multi-Directional pendulum:

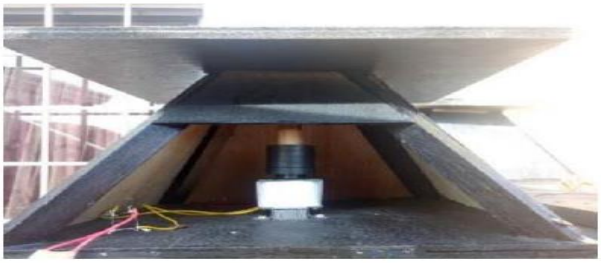

Fig.3: Multi-Directional pendulum

The prototype was designed to act like a pendulum linear generator, however, it generated voltage not only by swaying in one direction, but in any direction. The lowest part of the rod pendulum is where the magnet is placed. Underneath is the coil to cut flux. The rod connects the cylindrical frustum body and pendulum having a pivot point in between coil and

magnet shown in figure 3.The design in this process was based on physical set up for both pendulums, which aims to harness more induced voltages.

2] Working

The main component used in constructing the prototype is a linear generator made from neodymium permanent magnets; cylindrical frustum body used as flow path of wind to utilize wind vortices; pendulum is straightforwardly associated with the upper round and hollow frustum body to deliver the wavering to and fro movement going about as the central player of the direct generator; and a breeze checking framework used to record wind speeds. At the point when the breeze heading towards the pole, and creates the vibrations. That shedding effect the pendulum moves and produces a certain amount of kinetic energy. This kinetic energy is converted into electrical energy through the linear induction (e.m.f.) generator.

Main Components

1. Mast

Mast is a cylindrical tapered structure which undergoes oscillatory motion when encountering wind forces. The cylindrical structure of the mast enables the center of mass to be concentrated on a center line which is symmetric to the connecting rod. Wire frame structure is made with stainless steel rods of 2mm diameter. This wire frame helps the structure to be stable and light-weighted. The oscillations produced in the mast is due to Von-Karman principle of fluid flow. Vortex shedding is the phenomenon which occurs when a fluid flows past a body at a certain velocity. Due to vortex shedding, when the wind flow encounters an object, the objects encounter a phenomenon known as resonance and hence vibrates. In bladeless windmill, this phenomenon is used to resonate the mast within a varying speed range.

2. Connecting Rod

It is made of stainless steel. The connecting rod provides stability to the windmill structure. The stabilizer which is connected firmly to the base, minimizes energy dissipation. It takes up the motion from the mast and transfers to the electromotive force generator to generate voltage.

3. Linear Induction Generator:

An induction generator or asynchronous generator is a type of alternating current (AC) electrical generator that uses the principles of induction motors to produce electric power.

Induction generators operate by mechanically turning their rotors faster than synchronous speed. A regular AC induction motor usually can be used as a generator, without any internal modifications. Induction generators are useful in applications such as mini hydro power plants, wind turbine.

III. RESEARCH WORK

1. Vortex Bladeless Ltd. is a wind energy Spanish startup that was formalized in 2012 by David Yanez, David Suriol, and Raul Martin. In 2014, they officially founded the firm and could be exclusively dedicated to the development of Vortex. The original idea emerged in 2002 when David Yanez, the inventor, saw a video of the Tacoma Narrows Bridge (1940), disaster and led him to the idea that there is a lot of energy contained on the physical principle that collapsed the bridge, and it could be harnessed as a new way to generate energy from wind. His idea was kept in a drawer for years until 2012, when they began to look for investors and funding to start the project.
2. In early 2014, Vortex obtained public funding from the Center of the Development of Industrial Technology (CDTI) and began to collaborate with Barcelona Supercomputing Center (BSC) and their huge computing resources for the simulations on Vortex-induced vibrations (VIV), Magnetic field interactions, and finite element method magnetics (FEMM) researches needed for their development. The proof of concept was validated and the story of Vortex began winning the South Summit Award 2014 in the category of Energy and Industry.
3. In 2015, the firm began collaborating with representatives from the Massachusetts Institutes of Technology (MIT) and Harvard University. In the United States, the project reached the company Altair Engineering who offered their advanced simulation software to Vortex for their investigation on their Fluid dynamics concept. Also, NGOs and other environmental entities like Birdlife International have shown interest in this system and offered to collaborate, since Vortex may have a lower impact on nature and birds, especially as bigger wind power devices are built in the future. Thanks to the support from these public administration and research centers, in 2015, Vortex launched in June a successful crowdfunding campaign to fund the first supply agreements, and hire engineers needed to advance the project.
4. In late 2016, and after validating the technology on computer simulations and technology demonstrators, the company reached the prototype stage with a geometry that can harness a useful amount of energy from the wind with this principle. At this stage, Vortex was able to apply for funding from the Horizon 2020 for research and innovation program of the European Commission. Being the most funding that the company had, Vortex built a big wind tunnel, the tallest in Spain, for testing their systems, and began the development of their patented concept of an oscillating alternator with tuning system. On this phase, the company won the Seal of Excellence of the H2020 program.

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IV. RESULT

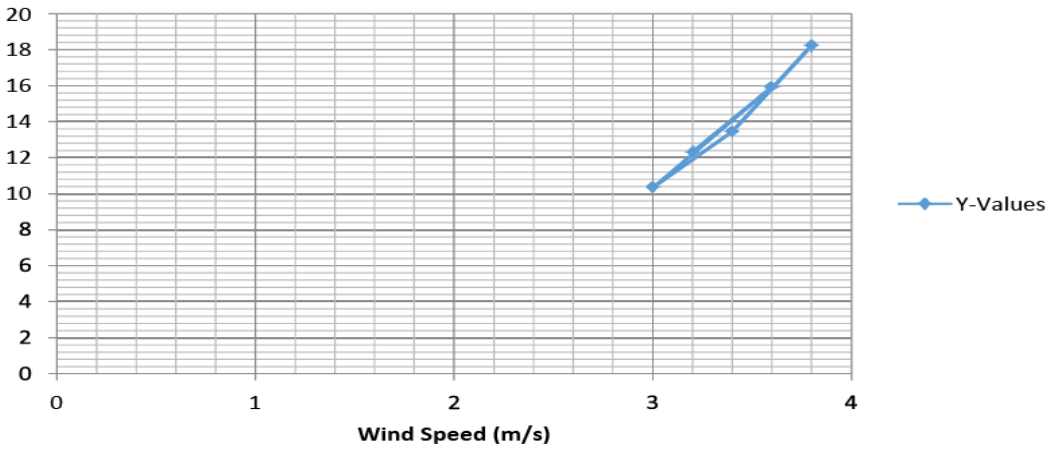

Fig.4: Wind Speed vs. Voltage Graph of the Arc shaped pendulum

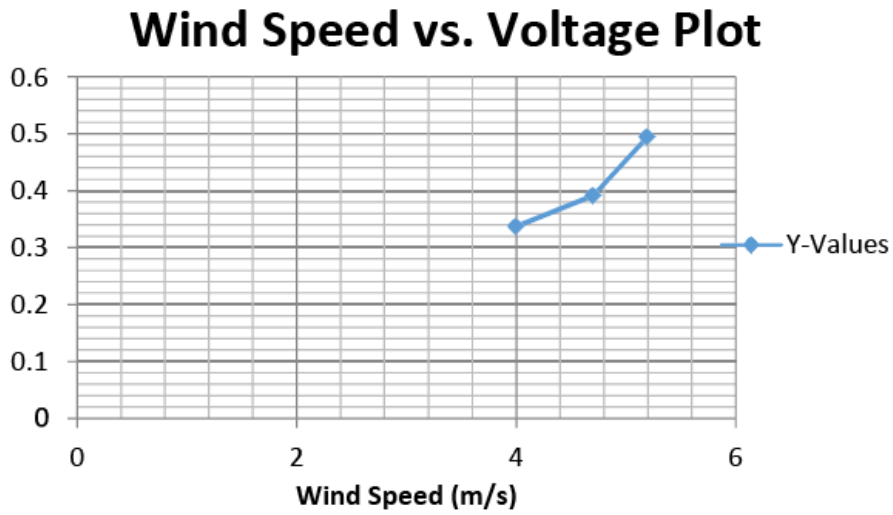

Fig.5: Wind Speed vs. Voltage Graph of the Disc shaped pendulum

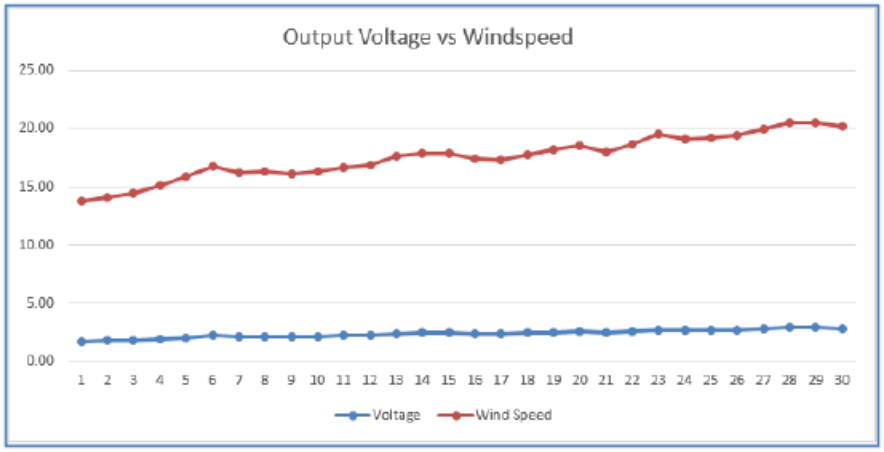

Fig.6: Wind Speed vs. Voltage Graph of the multi-directional pendulum

V. CONCLUSION

In this paper comparative study yields the arc shaped pendulum gave acceptable outputs in terms of induced voltage enough to light up LED bulbs as compared to that of the disc type pendulum. Observed factors like determination of the correct dimensions of cylindrical frustum body, location of the pendulum's center of gravity and exact positioning of magnets and coils to produce smooth swinging action of pendulum should be first considered because this definitely affect the swinging behavior of the pendulum in the actual set up. Result shows that the proposed arc pendulum yields better results in terms of voltage output compared to disc pendulum.

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