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VORTEX BLADELESS WIND TURBINE

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Abstract*— The abstract of this project is to investigate the possible extraction of power from wind energy by using a new conceptual vortex bladeless wind generator. It is designed by a hollow-shaped bluff body called a mast made up of four the body experiences vortex-induced vibration. layers(carbon pylac, poly fiber, synthetic resin, PVC) which are to be placed vertically on the ground. When the air passes through this bluff body, Due to the vortex shedding fluid phenomenon such vibration energy of the body can be converted into electrical energy. The traditional wind turbines are used to produce energy but their cost is very high and it may have many disadvantages like maintenance cost, running cost, friction loss and it is also dangerous to birds and is noisy as well.

***Keywords*—** *Mast, Oscillating coupler, Base, Carbon pylac, poly fiber, synthetic resin, PVC*

1. INTRODUCTION

Wind power represents 10.1% of the total installed power capacity in India as of 2020. Only Tamil Nadu and Gujarat installed wind projects. Wind installations in India were up about 117% in the third quarter of 2020, according to data from the Ministry of New Renewable Energy(MNRE). The increasing size of wind turbines is making wind power to be one of the most relevant energy sources.

However, in the distributed energy sector, where energy is generated close to the point of use, there is currently great interest in developing power generators based on renewable energy. While wind farms are now appearing across the landscape, they have met opposition in terms of their size and environmental impact on the quantity of electricity they can generate. About large-scale wind power, the vortex bladeless wind turbine is very promising. New wind generators with different characteristics exploitation of clean energy sources. Current wind power generators generally employ wind turbines These systems are inefficient and expensive to construct and maintain. They are also noisy, intolerant to damage, and relatively difficult to transport.

2. EXISTING SYSTEM

When the wind flows through the turbine blade, it creates kinetic energy which is converted into mechanical energy using shafts. The shaft is connected to the generator or alternator which is used to generate electric energy. From the generator the power flows through a rectifier which converts AC to DC and DC link is used to limit the fluctuations and then the DC is converted into AC using an inverter. "Control board and communication" the wind farm controller's function is “power management”.

It can initiate and shut down turbine operation as well as coordinate the operation of numerous wind turbines in response to environmental and operating conditions. The wind turbine supervisory controller manages the individual turbine operation. End-to-end communication forms the basis for the automation of wind turbines. Through self-optimization, automated wind turbines achieve a greater electricity yield. Measurement data and information about the status of the turbine are transmitted to the control room. A wind turbine is a revolving machine that converts kinetic energy from the wind into mechanical energy. The rotor is the area of the turbine that consists of both the turbine hub and blades. As wind strikes the turbine’s blades, the hub rotates due to aerodynamic forces. This rotation is then sent through the transmission system to decrease the revolutions. The transmission system consists of the main bearing, high-speed shaft, gearbox, and low-speed shaft.

3. PROPOSED SYSTEM

The proposed system is dependent on the speed of the wind, consider the speed of the wind is 6 m/s then the expected output will be 35 Wand for a nominal speed the expected output will be 100 W. Vortex bladeless wind turbine runs on the principle that when the wind is allowed to strike the column mast, it tends to vibrate and further converted to electrical energy via a linear generator. The output of the linear generator is passed to the controller unit, the output is stabilized and the pulsating output is given to the converter. In a converter, the voltage from the alternating current is converted into a direct current and it can be stored for future use or can be connected with the load.

4. BLOCK DIAGRAM OF PROPOSED SYSTEM

Below is the figure showing the block diagram of the system.

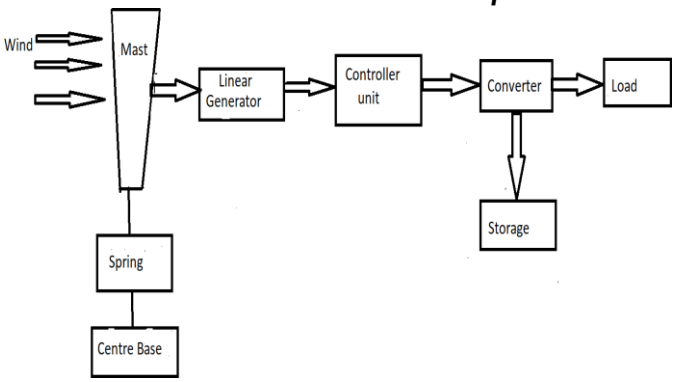

FIGURE 1: BLOCK DIAGRAM OF THE PROPOSED SYSTEM

5. METHODOLOGY

A. MAST

It is designed by a hollow-shaped bluff body called a mast made up of four layers (carbon pylac, poly fiber, synthetic resin, PVC) which is to be placed vertically on the ground. When the air passes through this bluff body it experiences vortex-induced vibration. Due to the vortex shedding fluid phenomenon such vibration energy of the body can be converted into electrical energy. Hence electricity is generated by a linear alternator.

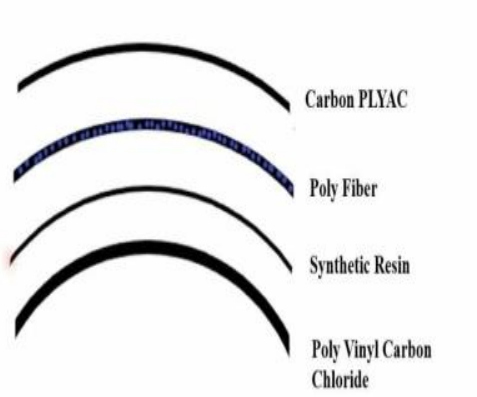

FIGURE 2: TYPES OF LAYERS USED FOR CONSTRUCTION OF MAST

TYPES OF LAYERS

[1] Polyvinyl chloride layer- provides strong structure to the mast.
[2] Synthetic rubber resin layer - prevents the mast from heat and acts as good heat resistance.
[3] Poly Fiber-It gives the grip required for the mast when the wind flows on it.
[4] Carbon Plyac - It prevents the generator from dust and other environmental defects.

B. PVC

The thickness required for the construction of the mast is 12 mm. Full polyvinyl chloride, a synthetic resin made from the polymerization of vinyl chloride. Second only to polyethylene among the plastics in production. A lightweight, rigid plastic in its pure form, it is also manufactured in a flexible "plasticized" form. Pure PVC applications are in the construction trades and structures where its rigidity, strength, and flame resistance are useful in pipes, conduits, siding, window frames, and door frames.

Synthetic resin

The synthetic resin thickness is required. for the construction of mast is 0.33 mm. they are industrially produced resins, typically viscous substances that convert into rigid polymers by the process of curing, to undergo curing, resins typically contain reactive end groups, such as acrylates or epoxides. Some are manufactured by esterification of organic compounds. The main difference between resin and plastic is that resin is mainly derived from plants whereas plastic is derived from petrochemicals. It can be normal for some resins, when poured in a thin layer, to be bendy. Poly Fiber-It gives the grip required for the mast when the wind flows on it.

Poly fiber

The thickness of poly fiber required for the construction is 0.8 mm. Poly-fiber is the only VINYL system on the market today. As it dries, it bonds extremely well to today's polyester fabrics and remains flexible. There are lightweight options, so it maintains the mast weight balanced. Poly-Fiber is not particularly sensitive to heat, cold, or humidity during the application or throughout its service life. Poly-Fiber offers choices in fabric weights and types of topcoats and has options for every aircraft from simple ultralight to the most.

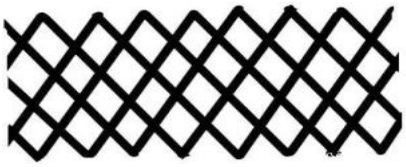

FIGURE 3: POLY FIBER

C. OSCILLATING COUPLER

Rotational–vibrational coupling occurs when the rotation frequency of an object is close to or identical to a natural internal vibration frequency. The animation on the right shows a simple example. The motion depicted in the animation is for the idealized situation that the force exerted by the spring increases linearly with the distance to the center of rotation. Also, the animation depicts what would occur if there would not be any friction. In rotational vibration coupling, there is an oscillation of the angular velocity.

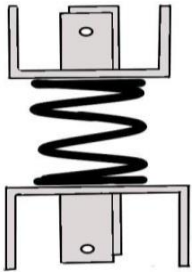

FIGURE 4: OSCILLATING COUPLER

D. BASE SECTION

The base section is mainly made up of two layers namely carbon place and Polyvinyl chloride. Base section is providing support to the mast because it holds the linear generator. It consists of three generator coils which are connected in series and placed in a generator tray. Each generator coil produces 4 volts ultimately the expected output voltage is 12 v.

FIGURE 5: BASE

6. HARDWARE COMPONENTS

A. BRIDGE RECTIFIER

The voltage source(linear generator) is connected with the bridge rectifier to convert AC to DC. Bridge Rectifier is a full-

wave rectifier that uses four or more diodes, diodes in bridge filters even the small frequency. The purpose of selecting a bridge rectifier is to control the current from bi-directional to uni-directional.

FIGURE 6: BRIDGE RECTIFIER

B. CAPACITOR

The output of the rectifier is given to the capacitor. It's a device used to store an electric charge, consisting of one or more pairs of conductors separated by an insulator. In power supplies, capacitors are used for filtering pulsating DC output after rectification.

FIGURE 7: CAPACITOR

C. INDUCTOR

Inductor – In-circuit, inductor is placed to resist change in current. An inductor also called a coil, choke or reactor is a passive two-terminal electrical component that stores energy in a magnetic field when electric current flows through it. The inductor is further connected with FET.

FIGURE 8: INDUCTOR

D. FIELD-EFFECT TRANSISTOR

FIGURE 9: FET

Field Effect Transistor – The components including capacitor, inductor, FET, and silicon diode are used to act as chopper circuits. The FET is a type of transistor that uses an electric field to control the flow of current. The output of FET is fed to a silicon diode.

E. SILICON DIODE

A diode is a widely used two-terminal circuit element that minimizes current in one direction(reverse bias), while easily carrying current in the other direction (forward bias). Finally, the chopper circuit regulates the output voltage and gives variable voltage to the load.

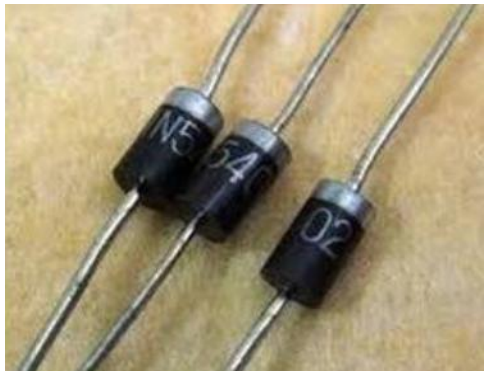

FIGURE 10: SILICON DIODE

F. GENERATOR COIL

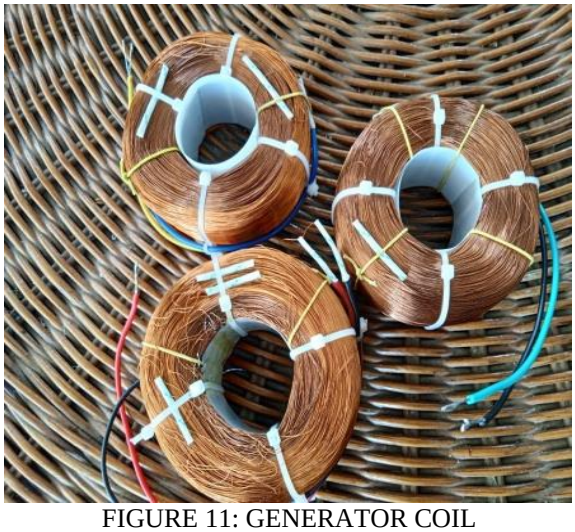

FIGURE 11: GENERATOR COIL

A field coil is an electromagnet used to generate a magnetic field in an electromagnetic machine, typically a rotating electrical machine such as a motor or generator. It consists of a coil of wire through which a current flow.

G. BATTERY

A battery is a device that stores chemical energy and converts it to electrical energy. The chemical reactions in the battery involve the flow of electrons from one material(electrode) to another, through an external circuit. It is used in a circuit to power other components. A battery produces direct current (DC) electricity (electricity that flows in one direction and does not switch back and forth).

FIGURE 12: BATTERY

7. CIRCUIT DIAGRAM

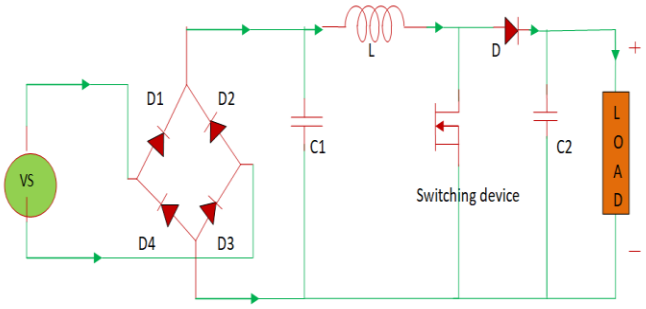

FIGURE 13: CIRCUIT DIAGRAM

The novelty is the use of linear generators. The voltage from the linear generator is considered to be a voltage source. Further, the voltage source is connected with a bridge rectifier to generate DC. Diodes present in the bridge rectifier are capable of filtering even the small frequency. In power supplies, a capacitor (C1) is used for filtering the pulsating DC output after the rectification so that a constant dc voltage is supplied to the load. The remaining components (inductor, silicon diode, FET, give variable voltage to the load. The expected output voltage is 12 v.

8. HARDWARE IMPLEMENTATION

FIGURE 14: HARDWARE KIT

9. RESULT OF PROPOSED SYSTEM

VBWT is designed for the rated power of 22W. The expected output voltage is 12 v. In the future, this prototype can be implemented and an output of 600W can be generated.

FIGURE 15: RESULT

10. ADVANTAGES

- A vortex turbine is 80% weight lesser than a conventional wind turbine.
- For maintenance, it does not need oil because there's no gear or moving parts in contact.
- It requires lesser land than a conventional wind turbine.

11. CONCLUSION

As such, this new technology would have enormous positive social, environmental, and energy impacts. Wind power currently produces about 1 .5% of worldwide electricity and has become one of the leading electricity-producing power sources in various countries. In the modern era, we don't have any sophisticated technologies in renewable resources so we move to the next level. VBWT is designed for the rated power of 22W. A vortex turbine is 80% weight lesser than a conventional wind turbine. It can be used in the sectors like Industries, agriculture, telecoms, off-grid lighting, off-grid rail signaling, off-grid power for rail signaling.

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