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A REVIEW ON PIEZOELECTRIC BLADELESS WIND TURBINE

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ABSTRACT

In the current phase, India is venturing towards turning out to be an all-inclusive superpower. This implies that it is leading the list of developing countries in terms of economic development. Therefore, the energy requirement of the country will increase at a rapid rate. Thepresent energy generation sources are less economic and non-eco-friendly. They require large investment and maintenance costs. Therefore, a turbine with easy design, guarded, quiet, economical, and straightforward working is the necessity of the hour. One such turbine is the Bladeless wind turbine which works on the vortex shedding effect.This turbine is the perfect replacement for the present traditional turbine which has many ruinous effects. Our project aims at such a turbine which doesn't require any fuelfor working, and so it is eco-friendly and henceforth it is a beneficial substitute for Traditional wind turbines. It uses a radically new approach to capturing wind energy. Its working principle is to make the hollow mast vibrate atresonating frequency generating vortices which are laterconverted into electrical energy by the help of piezoelectric sensors. Less moving parts are ensuring least structure vibration and hence negligible wear and tear. The structure also ensures better safety for the birds flying around as no sharp blades are rotating. Also, the consumption of space is less so, more number of units can be installed for large power generation.

***Key Words*:** Piezoelectric sensors, Resonatingfrequency, Vortices, Vortex Shedding**.**

1.INTRODUCTION

The piezoelectric bladeless wind turbine uses a new approach to capturing wind energy. It does so from the streamlined instabilities of the vortex shedding effect. As the wind bypasses around the structure, it changes its flowand creates an alternating pattern of vortices which later absorbed by the mast structure of the turbine and creates resonance by its oscillating motion. There is a classic example of the Tacoma Narrow Bridge of Washington, which collapsed within 4 months of its

inauguration due to the vortex shedding effect. Where all engineers and specialists try to avoid and reduce these vibrations from their technologies, we use it as our main source of energy. Hence the turbine comes out to be a renewable source of energy which is the major requirement of the present era. Rather than the same old tower, enclosure and blades, our device uses a fastened mast and a piezoelectric system. The energy created by the resonance in the mast is transferred to the disc attached at its bottom and later transferred to the piezoelectric system, where hence electricity is generated. This puts the technology at the low vary of capital intensity for such comes, it conjointly makes it extremely competitive not solely against generations of different or renewable energy, however even compared to traditional technologies.

Fig-1: Difference between conventional and bladeless turbines

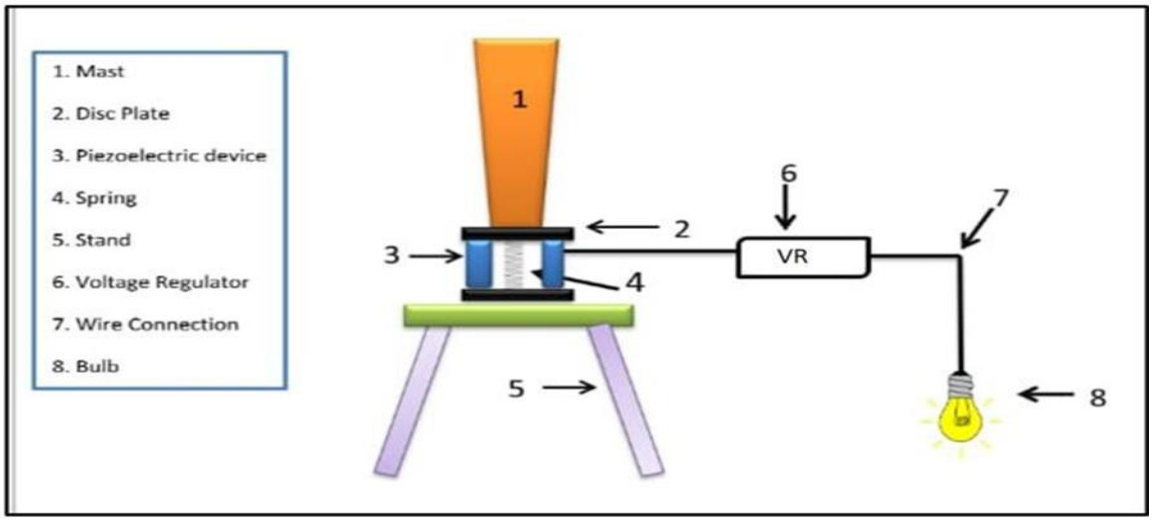

Fig- 2: Block diagram of Bladeless turbine

PARAMETER	CONVENTIONAL WIND TURBINE	BLADELESS WIND TURBINE
MODE OF OPERATION	It generates electric power with blades	It generates electric power without blades
MODE OF GENERATION	It captures wind energy using the rotational motion of the wind	It captures wind energy using oscillating motion
SAFETY	It is not safer for birds that suffer from a collision with blades	It is safe for birds and other flying animals
MAINTENANCE	It is not feasible to maintain as it has a high maintenance cost	It is easy to maintain and the cost of that is minimal
CONSTRUCTION	It has more moving parts	It has fewer moving parts
EFFICIENCY	It has high efficiency	It has comparatively low efficiency but overall is high

Table- 1: Difference between conventional and bladeless turbine.

1.1 Mast

A frustum shaped structure made up of PVC Pipe. It absorbs the aerodynamic effect taken from the environment and oscillates with the particular amplitude to generate energy which its later transfers to the corresponding components.

1.2 Discs

Two circular discs made of iron are used. On one of the discs, the mast is welded and is used for uniform application of induced stress on the piezoelectric chips, and the other disc is used to place the piezoelectric chips.

1.3 Piezoelectric System

It is used to generate an electric charge on the application of mechanical stresses. It consists of various sub- components like PCB board, Diodes, capacitors, etc.

1.4 Stand

It is the base onto which the whole step-up of the mast, disc, and the piezoelectric chip is mounded. It

provides strength and support to the mast for its oscillation at high frequencies.

1.5 Wires

Copper wires are used in the piezoelectric system for various connections and also to connect the battery and the LED bulb.

1.6 Battery

It is used to store the power generated by the piezoelectric system for later use.

1.7 Bulbs

The bulbs are used for lighting and to show the power output.

2. WORKING METHODOLOGY

The fundamental methodology we utilized in our undertaking is to convert the kinetic energy of air into physical-mechanical stress. After this, with the help of a piezoelectric sensor we covert that mechanical pressure into the alternating impulse of charge flow i.e., current. To saddle the active vitality of air, we use a vertical structure which is called the mast. The mast has a diverging cylindrical shape which is connected at the bottom of sturdy support through welding. It can be considered as a cantilever beam with uniformly varying load. At the point when air with high velocity makes an impact on the mast, it starts to vibrate with a certain amplitude and in a certain direction concerning the welded joint. As we know from the concept of resonance, every material has its natural intermolecular frequency. When that frequency matches the frequency of mast vibration, resonance occurs. Mast starts to vibrate with a larger amplitude and after that we covert the large amplitude vibration into vertical stress on the piezoelectric sensors through a metal plate called Disc which is welded at fixed support of mast. This vertical stress is transferred on to another plate on which our whole piezoelectric circuit is placed. Now we have successfully converted the air kinetic energy into the normal stress on piezoelectric sensors. When stress is applied on the piezoelectric sensor i.e., piezoelectric chips they produce charge which on connecting through wires produces current.

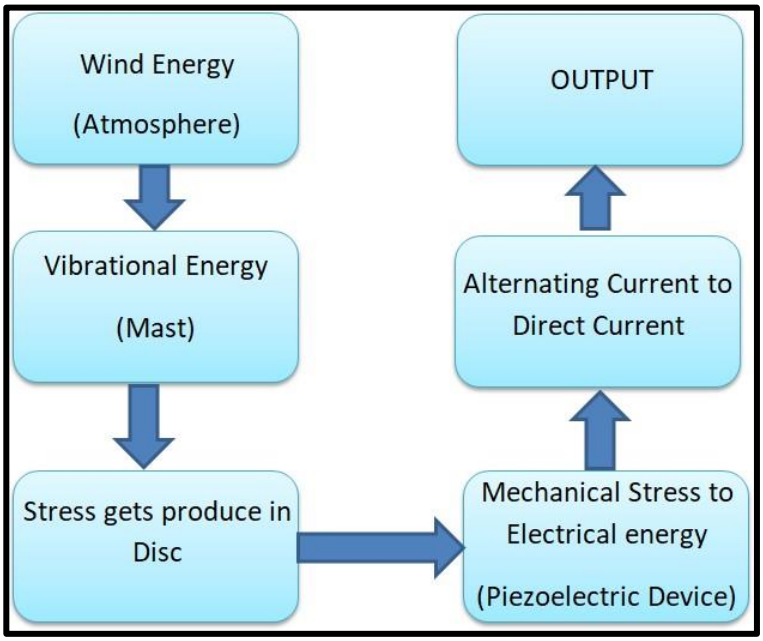

Fig- 3: Working of Bladeless turbine

2.1 BASIC WORKING OF PIEZOELECTRIC CHIPS

Piezoelectric sensors are the devices that convert mechanical stress into electric current. It has crystals of quartz that have the special property of developing a potential difference on the application of physical stress. The crystal of quartz has a hexagonal structure with the alternative presence of anion and cation on vertices. The center of symmetry of positive and negative ion is on the structural symmetry of figure i.e., on the centroid of hexagonal structure. On the application of stress, the center of anions and cations shift by some distance and create the potential difference and on connecting the wires with the crystal the charge tends to flow from the negative to a positive end. This flow of charges results in the flow of current.

3. CONCLUSION

Conversion of renewable energy into a useful form is the new approach which is gaining momentum in the past few years. The purpose of this project is to find an alternative for the traditional wind turbine. As we have used piezoelectric sensors in place of alternator and generator, the cost of this turbine is very much less than that of the normal bladeless turbine. Also, we have kept the size of this turbine compact, so we can easily install it in households, schools, and any rural area. Another advantage of our turbine is that it has less moving parts so the wear and tear will be less and hence the maintenance cost will get reduced. Overall, our piezoelectric bladeless turbine is economic, eco-friendly, and new innovation to the old approach.

4. FUTURE SCOPE

As we know, non-renewable energy resources are limited that's why bladeless turbine can be a better alternative for free energy generation through wind energy. This project mainly focuses on the generation of free energy which can be efficiently used in the industrial sector, lowering the cost of the project. As it is very handy and its installation iseasy, the problem of electricity in rural areas can be resolved. The use of piezoelectric bladeless wind turbines can be beneficial in the agricultural sector as the energy generated can be used to supply power to water pumps, fencing, and can easily be stored for later use. It can be used to provide power to transmission equipment in telecom industries so that they can easily expand to the rural area where power supply is the major problem. It can provide a small contribution to supply free energy to railway stations, airports, or other public places. By using this technology in the future, the percentage of usage of renewable energy for electrical power consumption will increase. It will work effectively in numerous spots like businesses, hospitals, schools, and so on. All this makes it very economical and furthermore, research on it can help us to reduce the cost and increase its efficiency.

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