

VORTEX BLADELESS WINDMILL

Dr. S. B. Sahare¹, Pooja.P.Thorat², Sumit Armarkar³

¹Professor S B Sahare, Dept. of Mechanical, YCCE, Nagpur, Maharashtra, India

²Pooja P Thorat, Dept. of Mechanical, YCCE, Nagpur, Maharashtra, India

³ Sumit Armarkar, Dept. of Mechanical, YCCE, Nagpur, Maharashtra, India

Abstract - In this project we focus on the renewable, non-conventional method for generating more clean energy from wind. The wind strikes the surface of conical Frustum with certain velocity and creates pressure on the mast. Cause it to oscillate to and fro motion. As the frequency of this motion increases, at certain point it matches with air frequency and resonance phenomenon occurs. Due to which Vortex Induced Vibration produces on the disc, causing the disc to rotate and exerts pressure (stress) on the piezoelectric chips to generate electric voltage. The induced voltage (charge) is then stored in the capacitor for transmission.

Key Words: Centre base, Conical Frustum, spring, Piezoelectric chip, Battery, Bulb 3watt etc.

1. INTRODUCTION

In Today's modern era, there are huge disturbances in the global Environmental climate change due to various factors like Green House gases, emission from the depletion of non-renewable resources like coal, petrol, oil, Natural gases etc and the only way to minimize the depletion and degradation of earth's environment is wisely to choose clean, natural and renewable energy. There are ample resources from which clean energy can be generated like solar energy, hydro energy, wind energy, geothermal energy and biomass.

Finding the right method of using renewable resource is ever growing more important as the earth's non-renewable resources continue to dwindle and also to provide a cleaner, healthier environment for the generations to come. Generating a clean energy through wind is one of the most affordable and efficient way of harnessing the energy for various purposes. Earlier wind mills are much predominant in use but due to its various drawbacks, a new device called Bladeless wind mill which is most efficient and covers every drawbacks of traditional wind mills.

The idea of bladeless wind mill inspired from Tacoma narrow bridge disaster in which the phenomenon of VIV is basically used here in bladeless wind mill. The construction of bladeless wind mill is quite simple as it uses the reinforced carbon fiber polymer material (conical frustum) as mast, center base, spring, piezoelectric material and Battery. Basically, the whole concept of bladeless wind mill is devoted to the Vortex Shedding Effect, it's a natural phenomenon when wind blows across any structure member, alternate cylindrical pattern are developed from one side to other

consequently, low pressure zones are created on the downside producing a fluctuating force acting at right angle to the wind direction.

2. BLOCK DIAGRAM

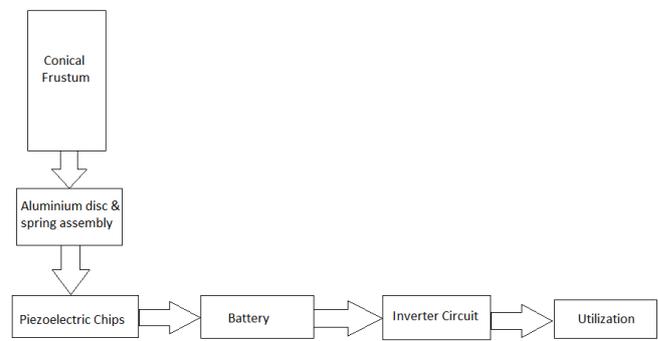


Fig -1: Block Diagram

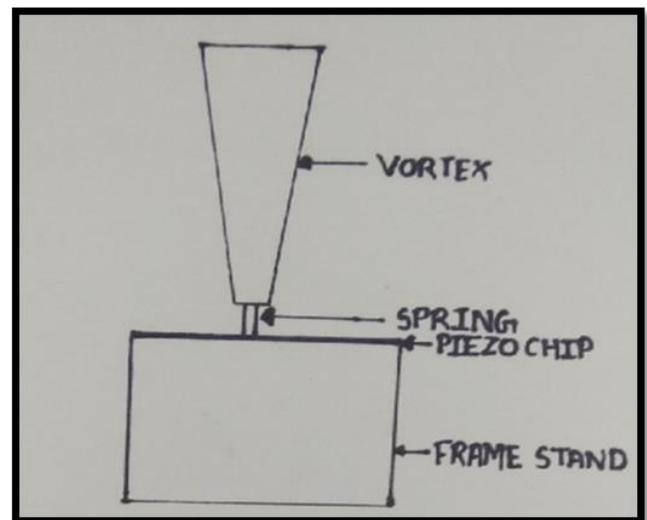


Fig -2: Actual Schematic Diagram

I. Centre base:

Base is made up of the iron structure which supports the model. The base provides equidistant point for the position of the mast. It is able to sustain the mechanical stress acting on

it. This system mechanism provides the strong frame base to the mast and adjoined springs.

II. Conical Frustum:

The mast is a conical shaped, rigid structure which oscillates when subjected to wind. The Mast is lighter in structure in order to increase the oscillations also decrease the mechanical stress on the suspension spring and Centre base of the system.

Considering notations as follows:

Du Upper diameter = 24 cm;

Dl= Lower diameter = 10 cm

L= Length = 111 cm; Fs= Oscillation frequency =2 Hz

The frustum is made up of polypropylene sheet of thickness 2 mm. Its function is to oscillation owing to the vortex shedding effect due to experiencing the air flow.

III. Disc:

20 cm iron disc with extension type springs. Its function is to bring the conical frustum in the original state and apply more pressure.

IV. Piezoelectric Material:

Piezoelectricity is the capability of certain crystalline materials to change mechanical energy into electrical energy and vice-versa. It shows relation between a mechanical stress and an electrical voltage in solids. This is reversible, an applied mechanical pressure will generate a voltage and an applied voltage will change the shape of the solid material 35mm piezo, 10 in one stack. 8 stacks in total.

Specifications:-

Weight = 3g;

Dimensions = 50*2.2;

Material = Brass;

Terminal = Wire type;

Resonant frequency=80±10;

Capacitance =1.5;

V. Spring:

Spring is mounted at the center of the mast which provides the oscillation of the mast in any of the direction. This spring is capable to withstand the weight of the mast. Made of Grade 17-7 stainless steel.

VI. Battery:

The battery used here is a 12V, 1.3 Ah, lead-acid battery. This battery will store the charge when the power is generated by piezoelectricity. This charged battery can be utilized for the use of consumer. Specifications: 12V, 1.3 Ah, 2.3kg.

VII. Load:

3W LED Bulb, Input Voltage: 230 AC, 50 Hz. The bulb is used to pose as a load to our system.

3. PRINCIPLE

When wind flows towards the leading edge of a bluff body, the pressure in the wind flow rises from the free stream pressure to the stagnation pressure. When the flow speed is low, i.e. the Reynolds number is low, pressure on both sides of the bluff body remains symmetric and no turbulence appears. When the flow speed is increased to a critical value, pressure on both sides of the bluff body becomes unstable, which causes a regular pattern of vortices, called vortex street or Kármán vortex street. Certain transduction mechanisms can be employed where vortices happen and thus energy can be extracted. This method is suitable both air flow and liquid flow.

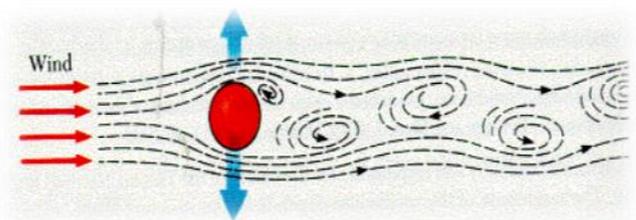


Fig -2: Vortex Shedding Effect

4. WORKING OPERATION

Input of system is air pressure which is kinetic energy, Due to kinetic energy vortex module vibrates. Vibration of vertical cylinder is in the form of linear motion. Due to the linear motion, spring attached to the vertex module moves back and forth and thus force is exerted on the piezo alternator. The alternator thus converts the force of vibration to generation of voltage that can be stored inside capacitor banks for transmission.

5. APPLICATION

- I. Bladeless wind mill can be used in industries, houses, schools, off grid power for rail signalling, lighting, farms and in remote telemetry also.
- II. We can use it on the highways where due to vehicles wind can be easily trapped and the maximum output can be taken out. Due to the passing of heavy vehicles from both the sides' mast can oscillate more often.
- III. Bladeless wind mill can be used for small scale energy production as well as large scale. It can be used in the farms for powering water pumping, powering lightning in stables and for small scale it can be used in houses.

Bladeless wind mill can be used in rail signalling to supply power to the signalling system.

6. ADVANTAGES

- I. It currently takes up as much as 30% of the area of a conventional generator, with maximum amplitude around a diameter at the top. It may capture At least 40% of the wind power present in the air.
- II. It is a cost effective solution because of the less wear and tear, maintenance cost is less also gear mechanism is not in involved.
- III. Piezoelectric material has a very high frequency response.
- IV. Piezoelectric material has small dimensions and large measuring range.
- V. Since bladeless wind mill does not have same magnitude of movement as traditional one, effect on bird population is expected to be much smaller
- VI. Less noise pollution.

7. DISADVANTAGES

- I. Abortion of wind is comparatively less than that of traditional wind mill.
- II. Height of the mast can be increased according to the output required.

8. CONCLUSION

We can conclude that the bladeless wind mill is a cost effective and greener wind energy generation system. The papers conclude that the bladeless windmill is one of the greatest wind energy generating process system. There are huge information's in generating ample Megawatt/hrs. of electricity in the coming future. The main purpose of this paper is to provide some fundamental results on the Bladeless wind.

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