Vortex Bladeless Wind Mill

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Abstract— Increasing population and industrial automation increases the demand of energy. To fulfil the gap between supply and demand of energy. There is a need of energy resources with using efficient solution. Wind Energy is a major source of energy in renewable energy sources. We are going to generate electricity by using bladeless wind mill. The main principal of electricity is piezoelectric effect. The work demonstrates the design and fabrication of bladeless rocking wind mill using roly-poly toy concept to harness wind energy. Electricity generated by pressure applied on piezoelectric sensor with the help of oscillating roly-poly toy .There will be no blades and no rotation so friction losses are reduced. It is eco-friendly concept.

Key words: Piezoelectric Sensor, FRP sheet

I. INTRODUCTION

Energy is a most important inputs for growth and human development. In the 21st century, secondary energy sources have been become the most indispensable part of society's needs. India is the fourth largest wind power producer in the world, after China, USA and Germany. According to the Ministry of New and Renewable Energy (MNRE) survey, a total capacity of 32848.46 MW has been established up to December, 2017. In wind power generation kinetic energy of the wind can be utilised by converting it into mechanical form and further into electrical energy. Wind energy is pollution free and a renewable source of energy. Successful harvesting of wind energy depends on the two basic variables of wind namely direction and speed. Green energy production based on concept of roly-poly toy (tumbler) shaped rocking wind mill is a radically new approach to harness wind energy. When wind strikes on structure it starts to oscillate. Due to the oscillation of the structure stress gets produced which is sensed by piezo. Piezoelectric materials having property to convert this mechanical stress into electrical energy. This produced electrical energy is used to charge a battery using a bridge rectifier circuit and a capacitor in the circuit.

A. Objectives:

- To increase the use of renewable energy source which is economical.
- Harnessing energy using bladeless wind mill is pollution free and would not alter the availability of conventional fuels.
- Promote the use of greener wind alternative
- Rural electrification
- Efficient way of harnessing wind energy

II. CONSTRUCTION AND WORKING

A. Component:

- Piezoelectric Sensor
- Vortex
- Roly-poly structure
- Battery
- Light weight material for pole (PVC)
- Glass fibre
- LED
- Frame

1) Piezoelectric Sensor:

Piezoelectric transducer are smaller in size and have rugged construction. It is the piezoelectric effect, to measure change in pressure, strain or force by converting them into electric charge. Different piezo materials are barium titante, lithium niobate and lead zirconate titanate (PZT).

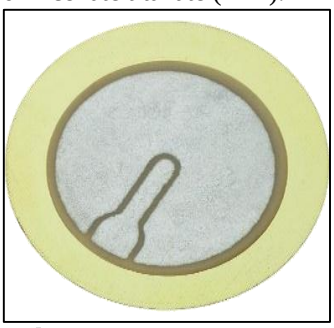

Fig. 2.1.1: Piezo sensor

2) Vortex:

It is a conical structure on which air get strikes and structure starts to oscillate due to eddies formation of air.

3) Roly-poly structure:

It is a structure having round-bottomed which tends right left when certain force is applied by air. The weight is placed such that the structure has centre of mass below the centre of hemisphere. When certain force is applied by air it tills by some angle and comes to its original position. Due to its weight balancing.

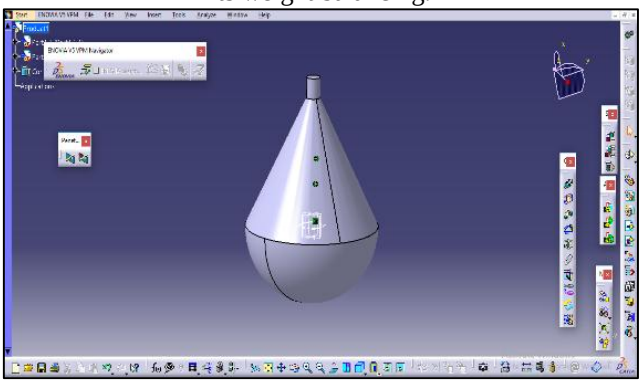

Fig. 2.1.2: Base model

4) Battery:

Battery is connected to rectified circuit to store fluctuating current.

5) Light weight material for pole:

Here, we are going to use any light weight material with high mechanical strength. For the model we going to use PVC, fibre plastic or aluminium. In real implement of the bladeless windmill the pole material should be such that it can

withstand any atmospheric condition for long time. With this, the weight of the material should be as low as possible so it can easily oscillate due to force of the wind. It should also sustain tension and compression.

Fig. 2.1.3: Fibre plastic material

6) Glass Fibre:

Glass fibre is a material consisting of numerous extremely fine fibres of glass. Glass fibres are much cheaper and significantly less brittle compared carbon fibre and polymers. Glass fibre are therefore used as reinforcing agent for many polymer product; to form a very strong and relatively lightweight fibre-reinforced polymer (FRP) composite material called glass-reinforced plastic (GRP).

Fig 2.1.4: Glass fibre mat

B. Working:-

When the air strikes on the vortex structure, eddies are formed, which helps the structure to oscillating. This oscillating structure produces stress on the piezoelectric sensor. Due to the property of the piezoelectric material to convert mechanical stress into electrical energy, electricity gets produced, this produced electricity is provided to rectified circuit.

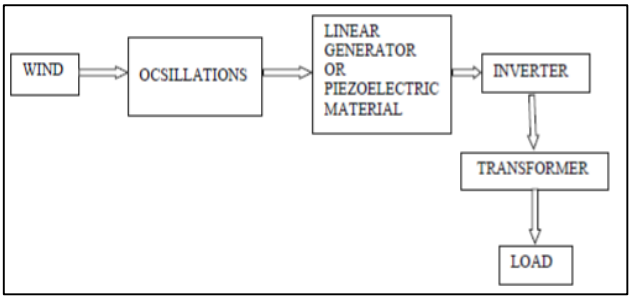

Fig. 2.2.1: Block Diagram of Bladeless windmill

Which can be further used for small scale application.

III. Specification of Components

A. Bottom Hemisphere:-

Radius = 145 mm Diameter = 290 mm
Thickness of FRP sheet
t = 2 mm
Surface area of hemisphere $A = 2\pi r^2$
$= 2 * \pi * 145^2$
= 132103.97 mm²

B. Design of Vortex:-

Area, A1 = 3.14*(r1+r2)*l
=3.14*(240+30)*350
= 296730 mm²

1) Mass of Vortex:-

Density of FRP =0.002 gm/mm²
M=density *A1* t
=0.02*296730*30
= 320 gm

2) Velocity of Air:-

Assuming velocity of air = (1600-4000) mm/sec
Area exposed to wind (A2).
A2= (R1+R2)*L
A2= 94500 mm²
Height = 270 mm
Slant Height, s = 135 mm

C. Surface area of Cone $A = \pi rs$

$= \pi * 145 * 135$
= 61496.67 mm

1) Force acting on the exposed area

Density of air = 1.225kg/m^3
V air =4 m/s
F =density * A2*V air
Volume of the mast (V)
V= (m/density)

2) Stress produced:-

Stress = (Force /Area)
Force = Mass*Accln
= 7 kg *3.5 m/s²
Area =132.10 m²
Stress = 0.185 N/m²

Output voltage produced will be in the range between 15 to 30 volts.

IV. Design Layout

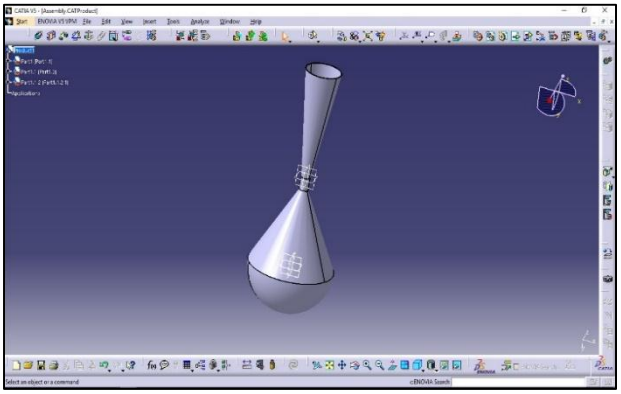

Fig. 4.0.1: Assembly

V. ADVANTAGES

1) This windmill has no blades. Thus there will be no friction due to less contact with air.
2) It also has no rotating parts with it. There will be zero friction losses due to rotation.
3) This windmill has no noise problem as there will no rotation.
4) With the implement of this windmill no bird will get harm or killed.
5) Many birds are killed or get harm due to existing windmill every year.
6) This windmill has maximum efficiency as there are minimum losses.

A. Disadvantages:-

1) Less power produce compare to blade windmill
2) Conclusion: -
3) This project is Eco friendly and lower cost compare to the windmill in this project making that advantage is no bird kills, no gear box so less maintenance cost. The blade less windmill in less space good efficiency.

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