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Review of Highway Wind Turbines Working on Impact Wind Energy from Automobiles

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Abstract - *The highway wind turbines were a notable idea in the field of free-energy production. The highway wind turbines used the impact wind energy from the moving vehicles to turn the blades and produce electricity to provide unlimited power source for streetlights and other public amenities. However, this concept was a failure. We had tried to address all the factors responsible for the implosion of the highway wind turbine. Also consider to explain the working and sections of the highway wind turbine. If the drawbacks can be eliminated, the highway wind turbine can produce clean fossil-free energy and maintain a constant source of power in the highways which has numerable applications.*

Keywords: Highway wind turbine, Impact wind energy.

1. INTRODUCTION

Wind-energy is the fastest growing source of clean energy. Even though the first wind turbine was build around 900 A.D [1], wind power is today a small addition to the world energy demand when compared to coal, nuclear, hydro and oil. However, today there is a global discussion about if the greenhouse effect [2] exists or not and if an oil crisis is waiting to happen[3]. In ancient times, wind energy is used to turn mechanical machinery to physical work, like crushing grain or pumping water. The majority of modern windmills are used to generate electricity by converting the rotation of blades into electrical current by means of generator.

The demand for fossil-free and clean energy increases worldwide more than 52GW of clean, emissions-free wind power was added in 2017, bringing total installations to 539GW globally. With new record set in Europe, India and in Offshore sector, annual market will resume rapid growth after 2018[4].

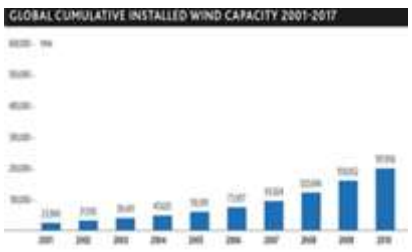

Fig-1: Global Trend In Wind Energy, Data From GWEC

2. VERTICAL AXIS WIND TURBINE

In this type of turbines, the main rotor shaft is oriented vertically instead of horizontally which is more common. The vertical axis wind turbine do not need to be pointed into the wind [5], which removes the need for wind sensing and orientation mechanism. A VAWT tipped sideways, with the axis perpendicular to the wind streamlines, functions similarly. A more general that includes this option is "transverse axis wind turbine" or " cross flow wind turbine. Drag type VAWTs such as the Savonius Rotor typically operates at lower tip speed ratios than lift based VAWTs such as Farriers and cycloturbines. Vertical turbines spin on the vertical axis and come in various shapes, size and colour. Its movement is similar to a coin spinning on the edge. The main difference between the VAWT and HAWT (horizontal Axis wind turbine) is the position of blades. The early versions of vertical Axis wind turbine like Savonius, Gyro-mills, Farriers were plagued by torque variation on each revolution of the turbine. They also suffer from large bending forces on the blades. The newer design (Gorlov type) alleviate some of those problems. The main types of vertical wind turbines are

2.1. Darrieus Wind Turbine

Darrieus wind turbine is commonly known as "Eggbeater" turbine. It was invented by Georges Darrieus in 1931. A Darrieus is a high speed low torque machine suitable for generating alternating current(AC) electricity. Darrieus generally require manual push therefore some external power source to start turning as the starting torque is very low. It has two vertical oriented blades revolving around a vertical shaft. Darrieus wind turbine must have an outside source of power in order to start them.

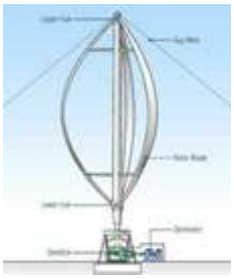

Fig-2: Darrieus model VAWT

2.2 Savonius Wind Turbine

A Savonius vertical Axis wind turbine is slow rotating high torque machine with two or more scoops and is used in high reliability low efficiency power turbine. Most wind turbines use lift generated by aerofoil shaped blades to drive a rotor, the Savonius uses drag and therefore cannot rotate faster than the approaching wind speed. As a drag type of turbine, these units are less efficient. This unit is larger than the Darrieus model. The Slow speed of Savonius increases Cost and produced this efficiency.

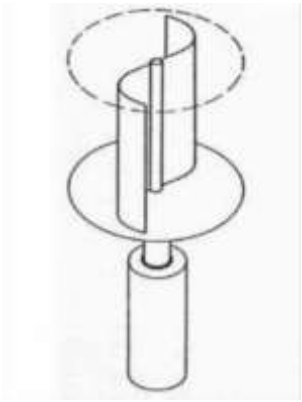

Fig-3: Savonius model VAWT

2.3 Gorlov Helical Wind Turbine

The Gorlov helical wind turbine evolved from the Darrieus turbine design by altering it to have a helical blades/foils. Gorlov helical turbine was invented by professor Alexander M.Gorlov of Northeastern University. The physical principles of Gorlov helical turbine are the same as for its main prototype, the Darrieus turbine, and for the family of similar vertical Axis wind turbine which includes also Tury wind turbine, aerotecture turbines. Gorlov helical wind turbine sold pulsatory torque issue by using the helical Twist of the blades.

Fig-4: Gorlov Helical wind turbine

3. HIGHWAY WIND TURBINE

The highway wind turbines are vertical axis wind turbines (VAWT). These used along the highways to power the street lights. Usually, street lights are proposed at the locations where pedestrian movement is dense. Street lights are also provided at toll plazas, truck lay bus, bus lay bus, interchanges and build up areas along the highway. The most commonly used blade design for the Highway wind turbines helical or Gorlov model. However, the helical blades produce more noise. The highway wind turbine works on the impact wind energy(It is the wind energy which flows around the moving vehicles due to the reaction of body motions). As the automobile moves on the highways, there is a creation of front and back pressure column on both sides of the road. The pressure column is created due to the imbalance of high pressure/low pressure energy band created by the automobiles. Due to these pressure band, wind flow and create pressure thrust. The pressure thrust of the wind energy can be converted into mechanical energy which can be converted into electrical energy with the help of placing harnessing system just nearby these wind turbine.

Although the highway wind turbines was a revolutionary step in fossil-free energy, it was quite a failure!

4. SECTIONS OF HIGHWAY WIND TURBINE

4.1 Blade (Helical Type)

The blades are the most difficult part of the design because they must be propelled by wind in any directions. This necessities that the blades are curved and angled so that as much surface area is exposed to wind draft from oncoming vehicles as possible. The blade must be light weight. The central column design is relatively simple. It is the hollow tube where the blades are attached.

Fig-5: Helical Blade (VAWT)

4.2 Power Generation Unit

The combination of lift and drag cause rotor to spin like a propeller and the turning shaft spin a generator to make electricity. The main wind terminology related to the power generation are start-up speed9speed at which the rotor and blade starts to rotate

4.3 Storage System

The electricity produced must be efficiently stored. The commonly used electrical battery is lead acid battery which converts stored chemical energy into electrical energy. During the discharge portion of the reaction lead dioxide (positive plate) and lead (negative plate) react with sulphuric acid to create lead sulfate, water and energy. During the recharge phase of the reaction the cycle is reversed the lead sulfate and water are electro-chemically converted to lead, lead oxide and sulphuric acid by an external electrical charging source.

Inverter

A power inverter or inverter, is an electrical device that changes direct current (dc)to alternating current (ac).

5. CIRCUMSTANCE FOR THE IMPLOSION OF HIGHWAY WIND TURBINES

There are many reasons behind the failure of the highway windmill.

(a) The design used for the blade was helical or gorlov model which require a wind cut speed of 3m/s[6] the helical blade design produce more noise since there are many highway wind mill aligned in a row it produce considerable amount of noise. Thus distracting the birds as well as humans.

b) The safety of the pedestrian are compromised. A huge amount of human labor is required to ensure the safety since it contain free moving part.

c) The high cost of production and the complexity of designing and manufacturing the helical blades of the turbine is also a factor which d e-promoted highway wind mills.

d) The rise in popularity of solar powered streetlight also played a part in the implosion of highway windmills.

e) Although the impact wind energy is reliable it depends upon the following factors.

1) The intensity /frequency of the vehicle traffic

2) The size of automobiles

3) The speed of the automobiles

4) Distance between the harnessing system and vehicle

5) Velocity of natural wind.

These made the engineers and designers to reconsider the highway windmills.

6. PRESENT REVELENCE

Being in July 2018 severe affected the south Indian state of Kerala due to unusually high rainfall during the monsoon season. The rescue of people and mobility of relief items for the flood victims were limited to daylight since the power supply was interrupted even in the highways. Even though in most parts of the national highway in Kerala, the streetlights were self powered by solar energy it could not help the situation. Since the solar panels were large in size, they were easily blown off by the wind leaving the roads in dark. If additional setup were installed in the same it can be avoided.

7. FUTURE SCOPE

The world is now in a time of transition from fossil-fuel to clean energy. In the coming future, the IC engines will be replaced. Our automobiles will completely run on electricity. Then, the highway wind mills can act as a charging hub which can charge the batteries of the vehicle if run out of power on the highways.

8. CONCLUSION

Even though the highway wind mills were a major break through in the wind energy field, the complication and the high cost of production of wind mills along with lack of safety decreased its popularity. The second generation of self sufficient and intelligent highway wind mills are required to back up the disasterous failure of its first generation. The complexity of the helical model blades should be eliminated. One of the best alternative for the helical type blades are the H-darrieus blades. To avoid the dependence on one source of energy, alternative clean fossil free energy from the highway should be developed.

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