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Vertical Axis Highway Wind Turbine

Pushpendra Kushwaha [1], Arun Verma[1], Amit Aherwar[2]

[1]*Student, Department of Mechanical Engineering, MITS, MP, India.*

[2]*Professor, Department of Mechanical Engineering, MITS, MP, India.*

Corresponding Author: pushpendrakushwaha247@gmail.com

Abstract: - Now a day the demand of electricity is higher than that of its production. The main aim of our project is to generate electricity by using the dynamic action of air created by the high speed moving vehicle in highways. The wind back created by the fast moving vehicle is wasted without any utilization. There are several places where the traffic is high all day long and in night also. In highways the vehicles face problems when travels in night time due to bad light, in highways. This problem can be overcome by using the "VERTICLE AXIS HIGHWAY WIND TURBINE". There are several places on roadways where the traffic is very heavy all day as well as night. The wind turbines will be installed at the middle of the highway's divider in a series combination. Therefore, air flow from either sides of the road will be considered in the turbine design. The motive of this project is to spread the knowledge towards clean energy in a feasible way. This paper focuses on use of wind generated by the fast moving automobiles on highway which will utilized by the wind turbine installed at divider. When the vehicle passed on the highway it produces a considerable amount of air due to its speed. This air tangentially strikes on the blade of the vertical axis wind turbine and its makes a rotation of the turbine blades which rotates the generator shaft and the electricity is generated. The electrical output of vertical axis turbine used for street lighting, toll gates, traffic lightning etc.

Key Words:— ***Vertical axis wind turbine, wind back, clean energy, generator.***

I. INTRODUCTION

At present time the major electricity is generated by the burning of the fossil fuel like coal. A very less amount of electricity is generated by hydropower plant and nuclear power plant. Wind energy is the fastest growing energy source of pollution less energy in world. There is availability of wind energy nearly constant on the highways due to fastest moving automobiles. We have designed vertical axis wind turbine which is more efficient than old savonius design. In modified vertical axis turbine, we twisted the blade of the turbine to gain maximum spin on low pressure of the wind, we also try to achieve less vibration at gear moment. The foundation of wind turbine should be strong enough that it can sustain the storm. This design of the blade enables the turbine to rotate in clockwise and anticlockwise directions. The turbine should be capable of utilizing the wind generated by the vehicle running either side of the divider.

II. PRINCIPLES OF WIND ENERGY CONVERSION

The wind flowing with the velocity V, contains the maximum energy (maximum available energy) when it cross through the cross section area A, will be 1/2ρAV3 [ρ is the density of the air]. The maximum power that can be extracted from a given wind stream is defined by what is known as the Betz limit, therefore, the power extracted is calculated by the following equation. Power extracted = 1/2Cp.ρAV3 (where the cp is the power coefficient). Power is directly proportional to the cubed velocity of the wind.

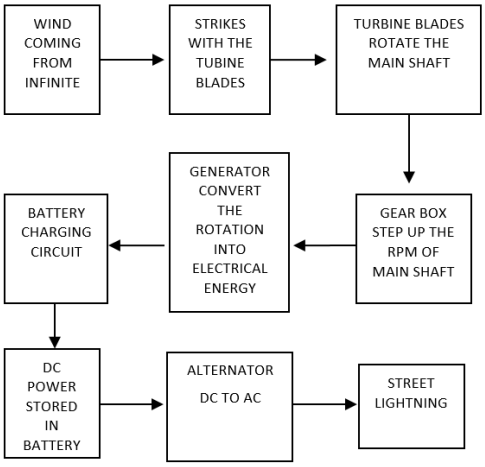

Fig.1. Block Diagram of Energy Conversion

III. AIRFOIL TURBINE BLADE GEOMETRY

An airfoil or aero foil is the cross-sectional shape of a wing, blade, or sail. An airfoil-shaped body moving through a fluid produces an aerodynamic force. Blades of the turbine play an important role to get maximum torque from the wind so its design is an important parameter. In order to get optimum lift,

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we use airfoil blades. In air foil the lift force is greater than the drag force.

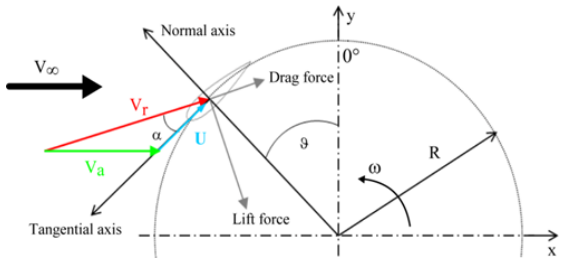

Fig.2. Forces on airfoil

Where,

V_∞= velocity of air coming from infinity

V_r = relative velocity at tip

V_a = velocity of air striking to the blade

R = Outer diameter of wind turbine

ω = angular velocity of hub

U = velocity of air foil (U= R*ω)

IV. Components Of The VAHWT

A. Rotor

It is consisting of two elements which are the wind turbine blades and the hub. The blades represent the flat part of the wind turbine that are directly fronting the air and they are the most important part of the turbine as it converts the kinetic energy of the wind into mechanical energy of the hub and main shaft.

B. Main Shaft

It is a piece of metal in the form of a tube which conveys the energy from the wind turbine blades to the other parts of the wind turbine. It transfers the energy of the rotational movement from the rotor to the generator. Main shaft should be designed in such a way that it can tolerate the fluctuation in the loads.

C. Gear Box

It is a mechanical device which consists of the gear arrangement which step up the rpm of the main shaft and it is connected to the generator.

D. Generator

It is in general a device that makes electricity from another source of energy. It takes the mechanical energy from main shaft and converts it into dc current. It produces 3 phase dc current which is stored in battery and then converted into ac current and further used for lightning.

V. Proposed Design

Our group is proposing to design a vertical axis wind turbine to utilize the wind produced by fast moving automobiles to generate the electricity. These turbines will be installed at the dividers between roadways that have high volume of fast moving traffic. The turbine blades arrangement will be aerodynamic which will give ease to utilize the both side air generated by fast moving vehicle.

The generated electricity will then be the stored in batteries. Since the electricity produced will be direct current (DC) it must be converted to alternating current (AC) before it can be used for lighting the street lamps. This means that the DC current must be pasted through an inverter first before it is used.

The turbine should be constructed in such a way that it can run under the wind speed of 5 m/s to 30 m/s. The height of the turbine should be 15 to 20 feet.

Fig.3. Structural Diagram (Front View)

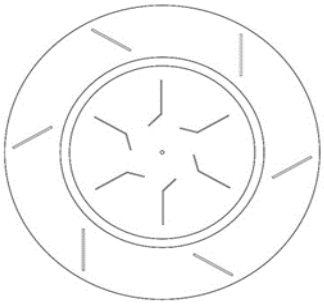

Fig.4. Structural Diagram (Top View)

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A. Material Used Various Parts

Component	Material
1. Blade	Aluminum
2. Main shaft	GI Steel
3. Hub	Aluminum
4. Bearing	Chrome steel
5. Battery	Lead acid rechargeable battery
6. Platform	Concrete

B. Cost Analysis

Component	Percentage Of Total Cost
1. Blades	10%
2. Platform	6%
3. Hub	5%
4. Drive Chain	12%
5. Generator And Alternator	28%
6. Main Shaft	15%
7. Installation And Grid Connection	24%

C. Design Challenges

Total Cost:

While designing we must consider the total amount of the project. The cost of designing the turbine, calculated in energy savings must be recovered in a reasonable time period.

Variable Wind Speed:

Each vehicle on the highway offers an intermittent and uncontrolled source of wind power. We should consider the average speed of the wind for design. Average wind speed will be 20 m/s.

Sufficient Energy Storing Devices:

The design of the wind turbine must include storage of power and a system to distribute the generated power effectively. There should be sufficient capacity of batteries to store the energy. Generated energy should not be wasted in lack of storing devices.

Environmental Conditions:

Operational noise level and space are other important design considerations. The wind turbines should have as little negative impact on the placement location as possible. This offers the additional challenge of having to transport the power generated to the location wherein it will be utilized. Fortunately, the wind turbine in this project is designed for use in high traffic areas where the demand for power is high.

Safety:

It is another major design consideration. The turbines must be placed in high traffic areas therefore several safety provisions are incorporated into the design. These safety measures include stationary highway guards surrounding the rotating turbine blades and warning labels.

VI. Conclusion

The vertical axis highway wind turbine is designed so it can able to capture wind from all the direction, power developed from the model is sufficient to run turbine. The efficiency of wind turbine can be increase by changing its shape and size of the blades. Airfoil blades are most efficient in power generation.

This project follows the government initiation towards the use of renewable source of energy. Wind energy does not harm the environment so it is also called green energy.

We have national highway at which the automobiles run with the speed of 100 km/h so this method of electricity generation will help in overcoming of energy crisis.

VII. Future Scope

Electric vehicle charging point:

By installing number of vertical axis highway wind turbine in series and parallel, power can have produced in megawatt. This power can be used to charge the electric vehicle.

Electricity supply to houses near highway:

As the demand and supply of the electricity is not same so in future the power generated by the system will be used for the commercial purposes.

Green energized world:

As the fossil fuels are consumed very rapidly, after few years there will not be the existence of fossil fuel. So the use of renewable source of energy will give us pollution free environment.

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