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Vehicle Mounted Wind Turbine for Battery Charging

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ABSTRACT

Air-conditioning for automobiles came into wide use from the late twentieth century. Although air conditioners use significant power; the drag of a car with closed windows is less than if the windows are open to cool the occupants. There has been much debate on the effect of air conditioning on the fuel efficiency of a vehicle. Factors such as wind resistance, aerodynamics and engine power and weight must be considered, to find the true difference between using the air conditioning system and not using it, when estimating the actual fuel mileage. Other factors can affect the engine, and an overall engine heat increase can affect the cooling system of the vehicle. Solve the problem of energy demands in vehicle for battery charging and for operation of air conditioner using renewable source of energy. The Electricity is Produce by using the vertical axis wind turbine which is place on roof of the vehicle and run by force of air created by the moving vehicle. We use arrangement vertical axis blade for power generation called as turbine for power generation. When the car moves with an average speed, the wind turbine attached to it also rotates. The turbine should be placed in such a way that the wind strikes the blades. This gives the turbine a rotational movement. The turbine is placed along the path of the wind flow path that is mounted on the car, then the blade rotates and energy is generated. When the car moves, the turbine rotates and this rotational energy can be converted into electrical energy via dynamo. Then further connection of dynamo is charge controller. Then this charge controller is connecting to battery.

Keywords: Air-conditioning, engine power, vertical axis wind turbine, dynamo, charge controller.

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I. INTRODUCTION

Air-conditioning for automobiles came into wide use from the late twentieth century. Although air conditioners use significant power; the drag of a car with closed windows is less than if the windows are open to cool the occupants. There has been much debate on the effect of air conditioning on the fuel efficiency of a vehicle. Factors such as wind resistance, aerodynamics and engine power and weight must be considered, to find the true difference between using the air conditioning system and not using it, when estimating the actual fuel mileage. Other factors can affect the engine, and an overall engine heat increase can affect the cooling system of the vehicle. Solve the problem of energy demands in vehicle for battery charging and for operation of air conditioner using renewable source of energy.

Energy Scenario

Non Renewable Energy

India is a country with more than 1.2 billion people accounting for more than 17% of world's population. It is the seventh largest country in the world with total land area of 3,287,263 sq kilometers. India measures 3214 km from north to south and 2993 km from east to west. It has a land frontier of 15,200 km and coastline of 7,517 km. India has 29 states and 7 union territories. It faces a formidable challenge in providing adequate energy supplies to users at a reasonable cost. [2] It has economy which is fastest growing economies in the world and experienced an average 7 % growth rate in the last decade. India accounts for 2.4 % of

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world energy production and stands at eleventh position in the world in energy production.

Renewable Energy

The research works on renewable energy sources over the past decade has increased energy production rate. The primary energy supply from renewable sources in 2004 to2013 – increase annually by 30% of the total supply. In 2013, renewable sources supplied approximately 19% of the world's final energy consumption, a little less than half of which came from traditional biomass. [1] India had about 28.1 GW of installed renewable energy capacity as of 31 March 2013. India is the world's fifth largest wind energy producer because wind accounts for 68% of the capacity, with 19.1 GW of installed capacity. Small hydro power (3.6 GW), bio-energy (3.6 GW) and solar energy (1.7 GW) constitute the remaining capacity.

Wind Energy

Wind is everywhere. As long as the Earth continues to rotate in the right conditions, it will remain that way. Wind generates when movement of air from areas of high pressure to areas of low pressure. When this mass of air is moving, it has energy that has been used to provide thrust to sailboats and ships crossing the oceans, to windmills used to pump water for irrigation or grinding up grain. Even today, wind is still used for much of the same reason as it was thousands of years ago, now days they are much used for to provide electricity. Today, only a small fraction of the world's electricity is generated by wind however, demand for this renewable energy resource will continue to increase with the depletion of fossil fuels. With an ever increasing energy crisis occurring in the world it will be important to investigate alternative methods of generating power in ways different than, fossil fuels. In fact, one of the biggest sources of energy is all around us all of the time, the wind. It can be harnessed not only by big corporations but by individuals using Vertical Axis Wind Turbines (VAWT). VAWT's offer similar efficiencies as compared with the horizontal axis wind turbines (HAWT) and in fact have several distinct advantages. One advantage is that VAWT can be placed independently of wind direction. This makes them perfect for locations where the wind direction can change daily.

II. PROBLEM STATEMENT

The luxurious life of 21st Century people along with increased travel demands has not only increased the number of vehicles on road but also a desire for more speed of the vehicle. Most of the Indian cities like Delhi, Mumbai, Kolkata and Chennai etc. have got busy highways like other global cities leading to continuous and speedy road wave turbulence. Motor vehicles have seen almost four times faster growth than population. In moving vehicle air-conditioning can significantly impact fuel economy and tailpipe emissions of conventional and hybrid electric vehicles (HEV) and reduce electric vehicle (EV) range or normal working engine vehicle. The opportunities to reduce this AC load on the engine include thermal load reduction and fuel consumption by use of VAWT (vertical axis wind turbine) for generating power as a backup supply for air conditional and other car application.

III. OBJECTIVE

Solve the problem of energy demands in vehicle for battery charging and for operation of air conditioner using renewable source of energy.

To genetarate electricity with the help of wind turbine which converts wind energy to mechanical energy to electrical energy.

To minimise the use of gasoline fuels in vehicles to save fuel and ultimately save environment for greater tomorrow.

To increase the efficiency of Vehicle by using no cost renewable energy i.e. wind energy

IV. LITERATURE SURVEY

[1] Gideon Quartey, This research targets the design of a wind turbine that will be mounted on the electric car to generate electrical power to charge the car batteries when in motion. The turbine is positioned on the roof of the car near the wind screen, where the velocity of air flowing around the car is highest due to its aerodynamic nature. A portable horizontal axis diffuser augmented wind turbine is adopted for the design since that is able to produce a higher power output as compared to the conventional bare type wind turbine. The air current is generated by the car when it begins to move. A frame is provided on the roof of the car to serve as a support for the turbine. Through the theoretical calculation on the power generated from the wind, a significant amount of electrical power (about 3.26 kW) is restored to the batteries when the car is moving at a speed of 120 km/h. The main components of the proposed design Were the rotor, main shaft, main bearing coupling, generator, top shroud, base shroud, inlet safety guard, exhaust safety guard. The rotor (1) is coupled to the main shaft (2) by a set of four hexagonal head bolts. The main shaft (3) and the generator (5) are fastened to the supports on the base shroud (6) by a set of hexagonal head bolts.

[2] Yuji Ohya, This research they developed a new wind turbine system that consists of a diffuser shroud with a broad-ring brim at the exit periphery and a wind turbine inside it. The shrouded wind turbine with a brimmed diffuser has demonstrated power augmentation by a factor of about 2–5 compared with a bare wind turbine, for a given turbine diameter and wind speed. This is because a low-pressure region, due to a strong vortex formation behind the broad brim, draws more mass flow to the wind turbine inside the diffuser shroud.

[3] Syed Alwee Aljunid, Vehicle Mounted Wind Turbine (VMWT) is a mounted horizontal axis wind turbine system for vehicles. This paper presents design and implementation of VMWT to generate electricity from vehicle. VMWT has several smart features including high rpm turbine, convenient weight, practical shape and portability. In addition, this paper evaluates the VMWT performance in terms of power generation. It is shown that, with proper designing, VMWT can generate approximately 200 W of power at vehicle speed of 80 km/hr. A number of design considerations have taken into account for designing

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VMWT to ensure its proper functionality in practical environment.

[4] Kaustubh Shete, Recently, scientists at the National Renewable Energy Laboratory (NREL) in United States were able to figure out that United States could save over $6 billion annually if all the light-duty vehicles in the country achieved a modest 0.4-km/L (1-mpg) increase in fuel economy. Their study also showed that the US uses 27 billion liters of gasoline every year for air conditioning vehicles. Factors affecting the AC load on the engine include climatic conditions, cabin conditions, compressor speed, difference between the climatic (outside) conditions, and overall efficiency of the AC system etc. The opportunities to reduce this AC load on the engine include thermal load reduction by use of advanced window glazing & parked car ventilation, the use of seat based climate control, recirculated air & by application of alternative cabin cooling techniques.

V. BLOCK DIAGRAM

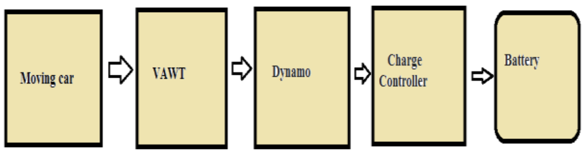

Fig. 1. Block diagram of VAWT

3D Cad model

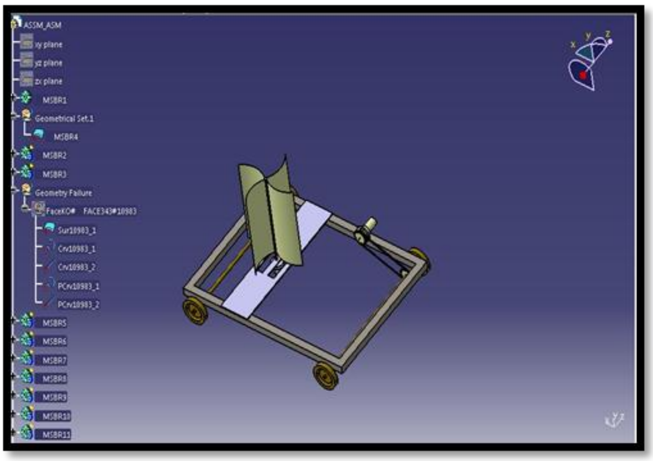

Fig. 2. 3D Cad Model of VAWT

COMPONENTS USED

Savonious Blades
DC Motor
Chain And Sprocket
Bearing
Square Pipe
Wheel
Shaft
DC motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

100 RPM Johnson Gear DC Motor 12V

The Johnsons DC Gear motor offers custom engineering solutions based on a wide range of low voltage DC and high voltage DC motor platforms. The low voltage DC platform provides power density and compact packaging options.

1) Features of 100 RPM Johnson Gear DC Motor 12V:

- Rotations per minute: 100 rpm with gear box.
- Output torque range: 5kg-cm to 7kg-cm.
- No-load current = 800 ma(max).
- Load current = upto 9.5 a(max).

Chain Drive
Most often, the power is conveyed by a roller chain, known as the drive chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system.

Sprocket
A sprocket or sprocket-wheel is a profiled wheel with teeth, cogs, or even sprockets that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed

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together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth.

VI. WORKING PRINCIPLE

For considering above mansion factor the main the objective of our project is to produce electricity in low cost with no effect on environment. The Electricity is Produce by using the vertical axis wind turbine which is place on roof of the vehicle and run by force of air created by the moving vehicle. We use arrangement vertical axis blade for power generation called as turbine for power generation. When the car moves with an average speed, the wind turbine attached to it also rotates. The turbine should be placed in such a way that the wind strikes the blades. This gives the turbine a rotational movement. The turbine is placed along the path of the wind flow path that is mounted on the car, then the blade rotates and energy is generated. When the car moves, the turbine rotates and this rotational energy can be converted into electrical energy via dynamo. Then further connection of dynamo is charge controller. Then this charge controller is connecting to battery.

VII. CALCULATION

Discharge:

Q = A*V
Q = 0.06*13.88
Q = 0.8333 m^3/min

Q = 0.8333 m^3/min

Input power P = $\frac{1}{2} * \rho * A * V^3$
ρ- Air density, (assume 1.093 kg/m3)
V- Wind velocity in m/s

$$P = \frac{1}{2} * 1.093 * 0.06 * 13.88^3$$

P = 87.68 watts

Gear ratio:
N1/N2 = 1
Therefore N1= N2

Output power of Turbine:

P = 87.68*1
P = 87.68 watts

FOR SOVENIOUS TYPE OF WIND TURBINE
SPCIFICATIONS
Rotor radius = R = 120 mm
Length of blade = L = 250 mm
No. Of blades = N = 4 blades
Initial angle of attack = αo = 0º
Blade chord = c = 20 mm = 0.020 m

- **Swept area**

S = 2 R L
where S is the swept area [mm^2], R is the rotor radius [mm], and L is the blade length [mm].
S = 2 * 120* 250
S = 60000 mm^2 = 0.06 m^2

- **Tip Speed Ratio**

$$TSR = \frac{Tangential\ speed\ at\ the\ blade\ tip}{V_o} = \frac{R\,\omega}{V_o}$$

$$\omega = \frac{V}{R} = \frac{13.88}{0.120} = 115.66\ m/s^2$$

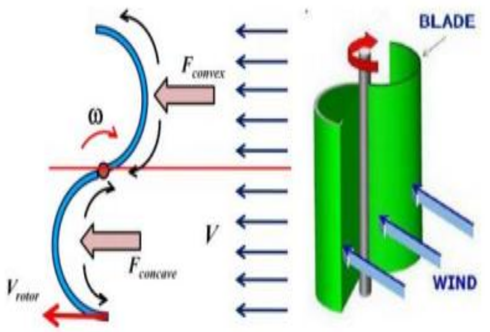
$$TSR = \frac{R\,\omega}{V_o} = \frac{0.120 \times 115.66}{13.88}$$

$$TSR = 1$$

- **Solidity**

$$\sigma = \frac{N \times c}{R} = \frac{3 \times 0.020}{0.120} = 0.5$$

Its working principle is extremely simple. The turbine rotates because of the difference of the drag force acting on the concave and convex parts of its blades.



Torque coefficient Ct: is the ratio between the torque in the rotor and the theoretical torque that the wind can cause

$$C_t = \frac{T}{T_w}$$

Where,
T = torque in the rotor
T_w = theoretical torque

$$C_t = \frac{T}{\frac{1}{4} * \rho * As * d * V^2}$$

$$T = 60 * \frac{0.0875}{2}$$

T = 2.625 N-m

$$C_t = \frac{2.625}{\frac{1}{4} * 1.093 * 0.06 * 0.120 * 13.88^2}$$

$$C_t = \frac{2.625}{0.3790}$$

$$C_t = 6.926$$

Advantages

- Free energy production from free source.
- Saves a lot of fuel and increases millage of vehicles.
- We get a constant wind speed in this type of energy production which is totally reliable
- Reduction in pollution as we are using less fuel for more distance with increase in millage of vehicle.

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- There are several reasons why we would choose a vertical axis wind turbine over a horizontal axis windmill.

VIII. CONCLUSION

Our work and the results obtained so far are very encouraging and reinforce the conviction that vertical axis wind energy conversion systems are practical and potentially very contributive to the production of clean renewable electricity from the wind even under less than ideal sitting conditions. It is hoped that they may be constructed used high-strength, low-weight materials for deployment in more developed nations and settings or with very low tech local materials and local skills in less developed countries. The Savoniuswind turbine designed is ideal to be located on top of a bridge or bridges to generate electricity, powered by wind. The elevated altitude gives it an advantage for more wind opportunity. With the idea on top of a bridge, it will power up street lightsand or commercial use. In most cities, bridges are a faster route for everyday commute and in need of constant lighting makes this an efficient way to produce natural energy

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