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Turbine jet wind mill

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***Abstract**:*

It is necessary to fully understand how to improve wind turbine efficiency, as energy consumption and cost reaches record-breaking levels. The cost of oil and nonrenewable resources is skyrocketing, and the depletion of these resources will require a sustainable and environmentally friendly energy source. An improvement to wind turbine efficiency will allow the limits of today to be surpassed, and someday be able to extract all of the energy from the wind with only a few improvements in technology Through the next several decades, renewable energy technologies, thanks to their continually improving performance and cost, and growing recognition of their Environmental, economic and social values, will grow increasingly competitive with Traditional energy technologies, so that by the middle of the 21st century, renewable Energy, in its various forms, should be supplying half of the world's energy needs. We have fabricated the small scale wind turbine on the basis of design calculations and made changes in design to track it with manufacturing constraints.

Keywords:

Fin, rotor, stator, diffuser, cowl, lobed mixer.

1. Introduction

A wind turbine is a device that converts kinetic energy from the wind into mechanical energy. The working of wind mill is very simple as the air comes in the structure the working blades rotates which is connected to main rotor shaft by the supporting arms the main rotor is coupled to a generator from where we can get the output. The power in the wind can be extracted by allowing it to blow past moving wings that exert torque on a rotor. The amount of power transferred is directly proportional to the density of the air, the area swept out by the rotor, and the cube of the wind speed. Jet turbine surrounds its wind-turbine blades with a shroud that directs air through the blades and speeds it up, which increases power production. The new design generates as much power as a conventional wind turbine with blades twice as big in diameter. The smaller blade size and other factors allow the new turbines to be packed closer together than conventional turbines, increasing the amount of power that can be generated per acre of land. This concept of a jet wind turbine was first implemented by the Flow Design Inc., a company dealing with renewable energy production, which is headquartered in the United States of America. Flow Design had modeled a prototype of a jet wind turbine and has tested it under various conditions. Tests were first conducted in the United States and subsequently it was found out that a jet wind turbine has more efficiency than a traditional wind turbine and that it has structural advantages over it as well.

2. Objective

The objective of this project is to work on an optimum wind turbine design using available analysis of the already designed wind turbines in order to create most efficient wind power harnessing wind turbine to produce cheapest and clean source of energy.

3. Literature Review

The working of wind mill is very simple as the air comes in the structure the working blades rotates which is connected to main rotor shaft by the supporting arms the main rotor is coupled to a generator from where we can get the output. The jet turbine design, which draws on technology developed for jet engines, circumvents a fundamental limit to conventional wind turbines. Typically, as wind approaches a turbine, almost half of the air is forced around the blades rather than through them and the energy in that deflected wind is lost. At best, traditional wind turbines capture only 59.3 percent of the energy in wind, a value called the Betz limit. Present day wind turbines only capture 50% of the air flow, cannot stand high winds, have high building standards, require many trucks to deliver parts for 1 turbine and have to be built tall and away from habitable areas. Due to their large size, the large turbines force air around it instead of through it and during high winds they are usually turned off or break due to their huge slow spinning blades. The power in the wind can be extracted by allowing it to blow past moving wings that exert torque on a rotor. The amount of power transferred is directly proportional to the density of the air, the area swept out by the rotor, and the cube of the wind speed. The

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mass flow of air that travels through the swept area of a wind turbine varies with the wind speed and air density. As an example, on a cool 15°C (59°F) day at sea level, air density is about 1.22 kilograms per cubic meter (it gets less dense with higher humidity). An 8 m/s breeze blowing through a 100 meter diameter rotor would move about 76,000 kilograms of air per second through the swept area.

The kinetic energy of a given mass varies with the square of its velocity. Because the mass flow increases linearly with the wind speed, the wind energy available to a wind turbine increases as the cube of the wind speed. The power of the example breeze above through the example rotor would be about 2.5 megawatts. As the wind turbine extracts energy from the air flow, the air is slowed down, which causes it to spread out and diverts it around the wind turbine to some extent.

4. Methodology

Flow Design Wind Turbine's innovative wind turbine, inspired by the design of jet engines, could deliver 300% more power than existing wind turbines of the same rotor diameter by extracting more energy over a larger area. Flow Design Wind Turbine's unique shrouded design expands the wind capture area, and the mixing vortex downstream allows more energy to flow through the rotor without stalling the turbine. The unique rotor and shrouded design also provide significant opportunity for mass production and simplified assembly, enabling mid-scale turbines (approximately 100 kW) to produce power at a cost that is comparable to larger-scale conventional turbines.
Many different methods of alternative energy are being evaluated in order to address the current crisis arising from the depletion of non-renewable resources. Wind energy represents a viable alternative, as it is a virtually endless resource. One of the more promising concepts in the wind energy field is the development of the Diffuser Augmented Wind Turbine (DAWT). These configurations use an additional diffuser to improve performance. The DAWT geometry concept has been analyzed using Clarkson's mRotor code with a focus on the Wind Tamer DAWT of Future Energy Solutions Inc of Livonia, NY. Preliminary calculations based on optimizing the original Wind Tamer geometries, indicate power coefficients peaking at Cp = 0.39, using commercial sizing. An optimization analysis in mRotor has indicated that power coefficients of nearly Cp = 0.5 for lower wind speeds, and even higher at faster wind speeds, can be achieved with minor design modifications. Full scale testing of this concept is underway at the Clarkson Wind Turbine Test site and will continue for several months.

5. Working

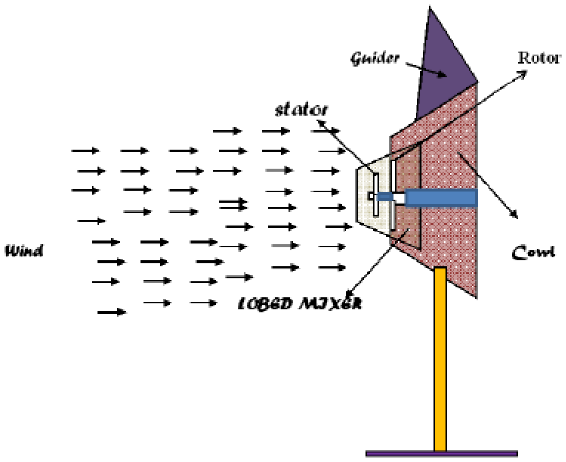

Figure show basic layout of new design

The Design model venturi is essentially a hole in the wall in front of a moving air mass. Venturi's discovery was that air moving through a venturi would gain speed. Much has been developed over the past two centuries in compressed air engineering to exploit the property. The drawings suggest that Flow Design has reached deeper into their experience and knowledge to increase the low-pressure area behind the generator blades. The double ring look suggests that the flow models offer a deeper low pressure and some compensation for the blade and generator blockage in the inner annulus or hole." now due to this it create turbulence and hence wind move out very fast. Flow design's MEWT (mixer-ejector wind turbine) is differentiated from previous DAWT's by using a lobed two stage diffuser to equalize the pressure over the exit area of the diffuser. The theory is that creating a uniform pressure distribution with the lobes and the injection of external flow will prevent boundary layer separation in the diffuser thereby allowing the maximum acceleration through rotor.
One such method of improving turbine efficiency is a Diffuser augmented wind turbine (DAWT) as an improvement to the conventional horizontal axis wind turbine (HAWT). DAWTs are simply a HAWT with a trumpet-bell-shaped diffuser surrounding the rotor blades and extending aft. A DAWT is claimed to have a greater efficiency than conventional HAWTs, even possibly higher than the Betz limit, because the diffuser allows for a greater pressure drop across the rotor blade. Wind energy conversion systems convert the power in the wind to rotational shaft power and to electricity by coupling a generator

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to the unit. Wind "turbines" is wind electric power units, and are used throughout the world. Commercial wind turbines range from a few hundred watts to about 20 kilowatts for rural applications. Units designed for grid connection are available in the range of 20 kilowatts to over one megawatt. Where annual average wind speeds exceed about 5 meters per second, residential and village-scale wind turbines can provide electricity at costs competitive with or below those of diesel generators, and can be used in stand-alone applications not requiring a local power distribution system.

6. Components

In order to extract energy from a larger area of the approaching wind, smaller, sturdier, and faster blades can be used. We try to design a new idea about the shape of fin, cowl, lobed mixer, rotor and stator. There are some of important parts in this new design of wind turbine jet. The new design of our wind turbine can be smaller than conventional turbine but can generate more power.

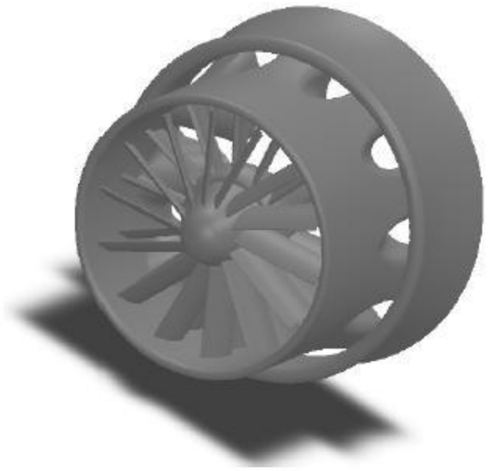


Figure show 3D model of New Design

Based on the concept of the jet engine's turbine, our wind turbines component can be divided into:

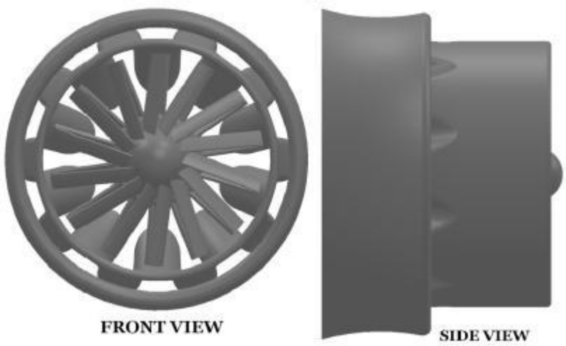
Rotor: The Rotor contains number of blades mounted on it, which rotates when the wind strikes on the blade guided by the stator. The rotor is attached to the generator shaft to generate electricity.

Cowl: The cowl is a flat circular cone type cover. It is the outer case of the lobed mixer.

Lobed Mixer: The Lobed Mixer is used for two directional flow of wind after wind passing from it and creating low pressure (vacuum) behind mixer which allows rotor to suck more wind and produce more output as compare to conventional wind mill.

Fin or guider: It is flat rectangular plate which is mounted on the cowl. It is used for the movement of the cowl towards the direction of the wind flow.

Stator : The Stator consist of fixed number of blades which guides the wind flow to strikes wind in perfect direction on the rotor so that it does not vibrate and moves smoothly with less resistance.



FRONT VIEW SIDE VIEW

7. Jet wind turbine power calculation

The specifications of our turbine are as follows: Rotor blades of 10'' x 6'' i.e. a rotor blade of 10 inches diameter and 6 mm pitch Thus, the rotor blade diameter becomes 10 x 25 = 250 mm Considering wind velocity = 10 m/sec

The power output of any wind turbine is calculated as, $Pt = ½ * \rho * A * V^3 * Cp$ [3]

Assuming density of air = 1.2 kg/m³ Also, Cp = power coefficient. It considers all the losses in aero turbine, gearing, mechanical coupling and the losses in the generator.

Power output of conventional turbine:

Power, $P = ½ * \rho * A * V^3 * Cp$ [3]

For conventional turbine the value of Cp = 0.35 For a rotor diameter of 250mm, swept area = $(\pi/4) * 0.25^2 = 0.049m^2$ Thus power produced, $P = ½ * 1.2 * 0.049 * 10^3 * 0.35 = 10.29$ watts

Power output of jet wind turbine:

Power, $P = ½ * \rho * A * V^3 * Cp$ [3]

For jet wind turbine value of Cp = 0.45 For a rotor diameter of 250mm, swept area = $(\pi/4) * 0.25^2 = 0.049m^2$ Thus power produced, $P = ½ * 1.2 * 0.049 * 10^3 * 0.45 = 13.23$ watts

A Force = mass x acceleration F = ma (Typical

M = density (ρ) x volume (Area x distance)

$= \rho \times A \times d$

$= (kg/m^3)\ (m^2)\ (m)$

= kg

= 1.2 x 0.196x 0.5

= 0.098 kg

Thus, by above calculations, we can say that for same specifications, jet wind turbine produces more power than conventional wind turbine.

8. Observations

In the jet wind turbine when the air is approached to stator, it acts as a nozzle that the velocity of wind increases and pressure decreases. Due to this, velocity of airfoil increases rotor spins and produce much power and decreasing pressure results in suction of wind.

With the specifications, which we have used to fabricate the model, earlier we used 10 stators and 4 rotor blades. But due to the 10 stators, the area at the front for passing the air was too less which was restricting the flow. It also resulted into less power generation than desired.

So, the only option available for us was to increase the frontal area, so that maximum air can pass through the turbine. For this, we reduced the number of stators to 4, and we got sufficient open area at front.

For the testing and operation of turbine, we used a moderate capacity blower which gave the air speed of around 9 to 10 m/sec. A dynamo connected to turbine blades at the back

Side, gave power output indication on millimeter in terms of voltage and current.

9. Conclusion

From above project we conclude that Jet Windmill Design is the most practical form of wind energy conversion at a very reliable cost. As electricity is a need of world it is also important thing in our daily life and wind is the cost free source of energy. From the calculations as well as the observations result we can say that, the concept of Jet Wind Turbine is more efficient than conventional turbine and produces 3 to 4 times more power. The efficiency of Jet Wind turbine increases due to its aerodynamic blade shape along with stator that guides wind to increase velocity and decrease the pressure to generate power.

Thus the concept of Jet Wind Turbine is simple adequate to remove many drawbacks of conventional wind turbine. The efficiency of Jet Windmill Design is about 45% compare to the conventional wind turbines of 35 % hence it is nearest to the Betz efficiency 59%. In future the development of wind turbine will be must because of clean source and cheapest method of energy generation, easily transportable & compact in size.

10. References

[1] G.D.Rai, "Non Conventional Energy Sources," Khanna Publishers in 1998.

[2] Leibowitz, Barry; Duffy, Robert, "Verification Analysis of the Toroidal Accelerator Rotor Platform Wind Energy Conversion System", prepared for New York State Energy Research and Development Authority, September 1988

[3] O'Brien, George; "Flow Design Has Innovation Down to a Science"; Business West, April 28, 2008

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