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Power Generation by Honeycomb Structure of Wind Turbines for Houses

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ABSTRACT—
At Present in India, supply of electricity in rural area is still a big challenge. Demand is higher than production and it is increasing rapidly. As known to all that non-renewable sources are rapidly decreasing and they are also hazardous for environment and human being, an example we had seen in Fukushima nuclear power plant, Japan in 2011. Renewable energy wills only the option to generate safe and pollution free electricity. Solar and Wind are good sources of renewable energy. At present wind energy is used to generate at utility scale only. We cannot use wind turbines at our houses due to its huge structure but we could use it if we will make some changes in its structure. To overcome this problem I have an idea to mdesign a honeycomb structure of wind turbines. In this design, structure will cover same area but it will increase swept area to provide more surface for wind to strike to turbine blades and can generate sufficient and efficient power for commercial use.[1]

INTRODUCTION

India was the world's third largest producer of electricity in the year 2013. India had total installed capacity of 261.006 GW as of end February 2015. As per report of central electricity report of 2014 total demand of electrical power in India is 1,048,672 MU and availability of 995,157 MU with shortage of 5.1%. India's Domestic household demand accounted for 28% of total demand. 71.57% of total electricity production in India is from non-renewable energy sources such as coal, petroleum, and natural gas and nuclear fuels and remaining 28.43% of production is from renewable energy sources. The total potential for renewable power generation in India is estimated at 94125 MW in 2013. Wind is the good source of Renewable power and has a good potential of 52.2% of total Renewable power in India.

For domestic households solar power is only option of Renewable power. Wind turbines are not suitable for domestic purpose because it requires more space and height. But towns or villages who are situated in heights and deserts could have possibility to use Wind turbines to generate electrical power with require some suitable changes in structure of wind turbines. To use wind turbines for domestic purpose they should be small and more efficient.

At present wind turbines, which are used in power plants, are mechanically separated but electrically interconnected and have a big structure that cannot be used on rooftop of houses and domestic buildings. My idea is to develop a structure which has mechanically connected wind turbines instead of electrically interconnected and I found honeycomb structure, inspired by beehive, will be suitable, strength able and capable for this purpose. Honeycomb structure is also used in furniture industry for preparing of wooden board because it has a good strength and efficiency.

ENVIRONMENTAL STUDY

This structure will be most suitable to desert and hilly area. I belong to Churu, desert area of Rajasthan state, where weather mostly remains warm and have good intensity of wind in summer. [4]Average speed of wind over a year in Churu was 12.6 km/h in between Apr 2014 to Mar 2015 with highest speed of 16.6 km/h and lowest speed of 10.4 km/h.

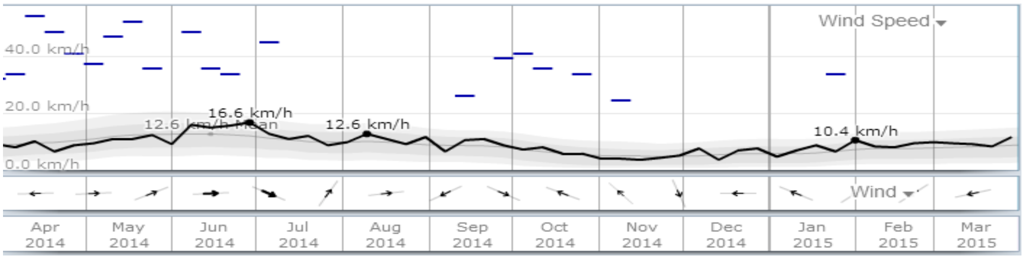

Fig. 1

Generally, average wind speed over a year required for a small wind electric turbine should be 14 km/h if using as a single unit. 12 km/h average speed will be sufficient for my designed structure to produce good enough electricity for households.

STRUCTURE

In this structure of wind turbines, rotor and rotor blades will be mounted on steel framed honeycomb structure and have rotors which will be connected in array of row and columns. Number of rotors is depending on our required output and environmental conditions. A group of rotors of a row will now connected to a single shaft through gear system and group of these shafts will further connected with generator which converts mechanical energy into electrical energy. Rotors will also have gear box and braking system for speed control when we get high intensity wind and to protect structure.

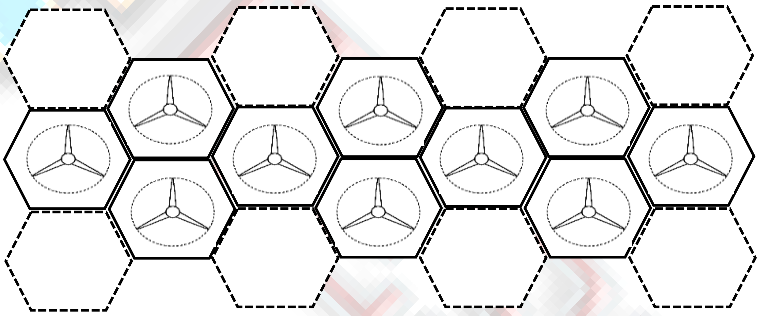

Fig. 2

If we are using wind turbine as a single unit, to produce power of 2kW to 10 kW, height and diameter of unit should be 100 ft and 18 ft respectively. But in this structure we won't need of too much height and diameter because it covers sufficient swept areas for wind to rotate wind turbine blades. So we could reduce blade diameter to 3-5 ft. To make structure light and durable we will use blades made by fiberglass.

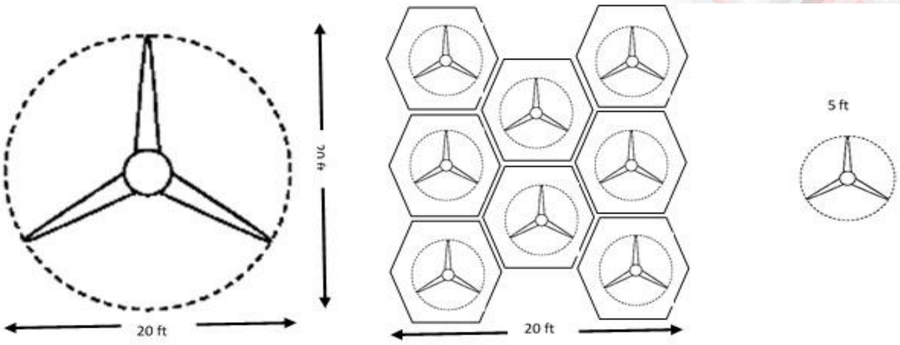

Fig. 3

CALCULATION

[5]Wind is made moving air molecules which have mass and any object which has mask and moving with a certain velocity carries kinetic energy that calculated by the equation and measured by Joules:

Kinetic Energy = 0.5 x Mass x Velocity2 …(i)

Air has a known density (around 1.23 kg/m3 at sea level), so when air hits our wind turbine, per second is given by the following equation:

Mass/sec (kg/s) = Velocity (m/s) x Area (m2) x Density (kg/m3) ….(ii)

And therefore, the power in the wind hitting a wind turbine with a certain swept area is given by equation and measured by Watt (Joule/s)

Power = 0.5 x Swept Area x Air Density x Velocity3 …(iii)

If we have one of our rotor blade size of 5ft diameter and have wind speed of 12 km/h (3.34 m/s) than rotor sweep an area of PI x $(\text{diameter}/2)^2$ = 39.25 ft^2 (3.64 m^2)

So wind power that will generated by one of turbine in this structure is = 0.5 x 3.64 x 1.23 x $(3.64)^3$ = 107.96 Watt (Joules/s). As the number of turbines will increased in structure output power will also increase on that multiple.

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