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Self Powered Electric Airplanes

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Abstract

The field of aeronautical engineering began to foresee its advancements in the future, the moment it evolved. Various new technologies and techniques were discovered and implemented almost in all branches of aviation industry. One branch where the researchers are continuously working for further more development is propulsion. Many new ideas are continuously being proposed. This paper deals with the use of renewable energy as the source of power for the aircraft. It gathers or creates the energy to move ON ITS OWN, it uses NO fuel. It is electric, having motors powered by electricity for propulsion. We are going to apply the same principle of electrical airplane and this can be operated as self powered electrical airplane. Here, starting power is provided to the engine and when engine gets maximum torque it starts generating current as per wind mill principle. As it produces electricity that will be used as the input for engine, so there is no need of any external electrical supply further. Efficiency of power produced can be increase to 100% by using electromagnetic generators. So the aircraft will be self driven and electrically powered.

Keywords: Renewable energy, Self-powered, Electromagnetic generators.

1. Introduction

This paper deals with the conceptual design of an electrically powered commercial aircraft that can carry 30 to 40 passengers. The main objective of this paper is to deliver an aircraft design pattern that makes use of renewable energy as the source of power which will meet the future requirements globally as well as to improve the performance of electric airplanes as self driven airplanes by implementing principle of wind turbines and aerodynamics of wind turbine blade. The main citation is to extract electrical energy from the wind through the combinational aerodynamic design of a propeller blade and a wind turbine blade. This idea is inspired from the conventional wind mills which are used for extraction of electrical energy from wind. The aircraft design involves the usage of an electrically powered propeller engine.

2. Sections

2.1 History and Development:

The design and development of electrically powered airplanes began in the early 1970’s. Initially electrical power was coupled with solar energy for power production. No direct source of electrical energy is being used for propulsion and power production till date. In 1979, the first electrical flight SOLAR RISER soared to a altitude of 40 feet and flew for a distance of 1 mile. 1981 was big year where two Europeans namely Gossamer Peguin and Paul MacCready designed a glider namely SOLAR CHALLENGER which set a record of flying non-stop from Paris to England at an altitude of 14300 feet. Antares 20E is the first certified electric aircraft which was produced by Lange Aviation in the year 2003. Recent developments involve the usage of retractable propellers which is an innovation brought by Pipistrel.

3. An Overview over Wind Turbines:

Wind turbines are broadly classified into two types as Vertical Axis Wind Turbines and Horizontal Axis Wind Turbines (HAWT). HAWT are the conventional wind turbines that are widely used just because it has got higher efficiency and fewer losses when compared to Vertical Axis Wind Turbines (VAWT). Wind turbines are mainly used for the extraction of energy form the wind. The extracted energy is then converted to electrical energy with the help of an electromagnetic generator. Wind turbines generally work very efficiently under laminar flow conditions at higher altitude.

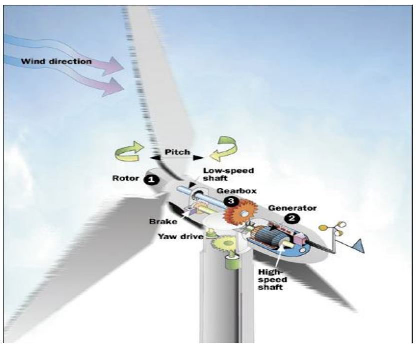

Figure 1: Electromagnetic generator and gear box
Assembly in a typical wind turbine

3.1 Conceptual design of Self Powered Electric Airplane:

The principle of wind turbine and electrically powered airplanes brought about a new idea in the design of self powered electric airplanes, where the propeller blade is designed in such a way that it performs both the operations of a typical aircraft propeller as well as a wind turbine. We all know propellers in aircraft are for providing thrust. This is achieved by providing some initial power to the propeller. As mentioned above, here the rotor blade acts dually as an aircraft propeller which is electrically powered with the help of a electrical motor as well as a wind turbine. On continuous rotation of the blade, energy is extracted from the wind which is then converted to electrical energy. This electrical energy is an extra source of power for the performance of the engine. The engine construction and design is similar to that of a normal propeller engine. The only major advancement made here is that the attachment of a electromagnetic generator with gear box setup on the shaft of the engine. This is the point where the rotor blades acts dually as a propeller as well as a wind turbine, extracting energy from the wind and that is converted to electrical energy with the help of electromagnetic generator assembly on the engine shaft. When the aircraft is in ideal condition on the ground, the propellers will be stationary. In order to initiate rotation of the propellers some initial energy has to be delivered. This is achieved with the help of a battery. When the minimum required RPM is achieved, the aircraft can take-off. Once the propellers attain required RPM, electromagnetic generator starts generating electric power from the extracted energy in relative proportions. When the aircraft is in the cruise phase, additional wind energy is available which can be used effectively for the extraction of additional electrical energy. This electrical energy generated by the electromagnetic generator is stored in the external battery. This stored electrical energy is used as the source of power for the continuous effective operation of the propeller engine. Through this it is understood that this aircraft is self powered by the continuous extraction and usage of wind energy.

4. Aerodynamics of Wind Turbine Blades:

Wind turbine blades are shaped to generate the maximum power from the wind at the minimum cost. Primarily the design is driven by the aerodynamic requirements. In particular, the blade tends to be thicker than the aerodynamic optimum close to the root, where the stresses due to bending are greatest. It might seem obvious, but an understanding of the wind is fundamental to wind turbine design. The power available from the wind varies as the cube of the wind speed, so twice the wind speed means eight times the power. The limitation on the available power in the wind means that the more blades there are, the less power each can extract. A consequence of this is that each blade must also be narrower to maintain aerodynamic efficiency. The total blade area as a fraction of the total swept disc area is called the solidity, and aerodynamically there is an optimum solidity for a given tip speed; the higher the number of blades, the narrower each one must be. In practice the optimum solidity is low (only a few percent) which means that even with only three blades, each one must be very narrow.

To slip through the air easily the blades must be thin relative to their width, so the limited solidity also limits the thickness of the blades. Furthermore, it becomes difficult to build the blades strong enough if they are too thin, or the cost per blade increases significantly as more expensive materials are required. For this reason, most large machines do not have more than three blades. The other factor influencing the number of blades is aesthetics: it is generally accepted that three-bladed turbines are less visually disturbing than one- or two-bladed designs.

4.1 How blades capture wind power:

Just like an airplane wing, wind turbine blades work by generating lift due to their shape. The more curved side generates low air pressures while high pressure air pushes on the other side of the aerofoil. The net result is a lift force perpendicular to the direction of flow of the air.

4.2 Betz coefficient and criterion, performance coefficient Cp:

The performance coefficient or efficiency is the dimensionless ratio of the extractable power

P to the kinetic power W available in the undisturbed stream:

$$Cp = \frac{P}{W}$$

$$Cp = \frac{16}{27} = 0.59259 = 59.26\%$$

This is referred to as the Betz Criterion or the Betz Limit. It was first formulated in 1919, and applies to all wind turbine designs. It is the theoretical power fraction that can be extracted from an ideal wind stream.

5. Conclusion

Through this concept we are able to see that the aviation industry will become even more environmental friendly by the usage of renewable energy replacing conventional fuels which are being used these days. It is also evident more and more power concepts will be bringing revolutionized ideas in the field of aviation and propulsion with the various other renewable sources thereby protecting our fragile planet.

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