EFFECT OF SOME DESIGN PARAMETERS ON THE PERFORMANCE OF A GIROMILL VERTICAL AXIS WIND TURBINE

BY

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PREFACE

This dissertation is submitted in partial fulfillment for the degree of Master of Science in Mechanical Power Engineering, Ain Shams University.

The work included in this thesis is carried out by the author at the laboratories of Mechanical Power Engineering Department, Faculty of Engineering, Ain Shams University.

No part of this thesis has been submitted for a degree or qualification at any other university.

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ABSTRACT

The Thesis describes the effect of some design parameters on the performance of a Giromill Vertical Axis Wind Turbine. A Giromill wind turbine has been designed, manufactured and tested. The turbine performance has been investigated with varying the design parameters such as, pitch angle, number of blades, airfoil type, turbine radius and blades chord length. Then, the results were used for the comparison between the performance achieved while changing the design parameters.

Many experiments have been performed with changing the above mentioned parameters. The effect of each parameter on the power coefficient and torque coefficient has been studied and explanation of the results was also discussed. It has been found that the pitch angle, turbine radius and chord length have a significant effect on the turbine performance.

SUMMARY

A Giromill Vertical Axis Wind Turbine has been designed, manufactured and tested. The effect of each parameter of the following: Pitch angle, radius of turbine, number of blades, airfoil types and chord length have been studied through experimental work which constitute many experiments of measuring the performance of the turbine while changing the above parameters.

The maximum power coefficient obtained in this research was 25% using turbine radius of 40 cm, chord length 15 cm, pitch angle of 10°, airfoil type NACA 0024, and four blades (which is found to be the best configuration in this study). For the effect of pitch angle, the obtained maximum power coefficient is decreasing, this decrease in performance was due to increasing in the pitch angle above 10° and also due to decreasing it below this value showing the high effect of pitch angle. It was also noticed that, when decreasing the turbine radius to 20 cm the maximum power coefficient is much decreased. Moreover, decreasing the chord length to 12 cm decreases the maximum power coefficient significantly, which again show the high effect of turbine radius and chord length. In order to compare the effect of airfoil type; the blades with NACA 4420 & NACA 4520 were used compared to NACA 0024 at the same above

parameters of turbine radius 40 cm, chord length 15 cm, pitch angle of 10° and four blades. The maximum power coefficient obtained with the cambered airfoils was 15%. Finally the effect of the number of blades have been investigated using two, three and four blades at 0^0 pitch angle and the same other above parameters of turbine radius 40 cm, chord length 15 cm and airfoil type NACA 0024. The obtained maximum power coefficients were decreased significantly when decreasing the number of blades from four to two blades.

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