Introduction

The Filippini Vertical Axis Wind Turbine is the result of more than three years of research into the development of a wind rotor design suitable for waterpumping application in rural Ethiopia. The inventor, Armando Filippini, with the support of Dr. Pierre Gouin, Director of the Geophysical Observatory, University of Addis Ababa, has devoted much time to the modelling and testing of various configurations for this vertical axis wind machine. From his studies, he has found the present configuration to be the most satisfactory.

The wind rotor, although it is a vertical axis machine of which there are many types such as the Savonius rotor, cross flow rotor or Darrius rotor, must be classified as a separate vertical axis design. It incorporates novel design features and operating characteristics that are not inherent in any other single vertical axis wind rotor design.

The simplicity of design and suitability of performance over a large range of operating conditions make this machine a very good choice for construction and installation in many regions of the world where the choice of materials and labour skills may be limited.

As a vertical axis wind rotor, the Filippini design has all the advantages of vertical axis machines. It can receive wind from any direction without requiring orientation of the rotor into a plane perpendicular to the wind. This means that no orientation gear is required as is the case for horizontal axis machines. Not only is this a simpler arrangement, it often enables the rotor to capture wind gust energy if the aerodynamic response of the rotor is rapid enough. This may increase the output of a rotor significantly in gusty wind regimes where most of these gusts are not from the same direction as the mean wind stream. Since the output shaft is already in the vertical plane, power can be transmitted to the bottom of the tower without the need of a right angle drive or rotary-to-reciprocating motion linkage to be located at the top of the tower.

Design and Operation

In its present configuration, the Filippini wind rotor can be described as having three blades located on the end of each rotor arm. The blades are made up of two parts, a leading bucket and a plate trailing in the wake from the bucket. To reduce end losses from the blades, endplates are fitted at top and bottom. Details are shown in figures 1 and 2 .

It is the addition of the trailing or splitter plate which sets this turbine apart from other vertical axis machines. The combination of the semi-circular bucket and splitter plate work together to give the rotor a very broad operating range.

The buckets ensure that the rotor will self-start even in light winds. There is a drag differential between the concave and the convex sides of the buckets so that a net torque is produced in the preferred direction of rotation. It is possible that the trailing plate may enhance this effect by directing the oncoming flow into the blades during start-up. As the polar diagram of starting torque shows, figure 3, there is no approach angle that a wind can take without producing a net starting torque. For the smoothest operation and best low speed torque, three blades is the preferred configu ration. Interestingly enough, the rotor will self-start even if only one blade is in place.