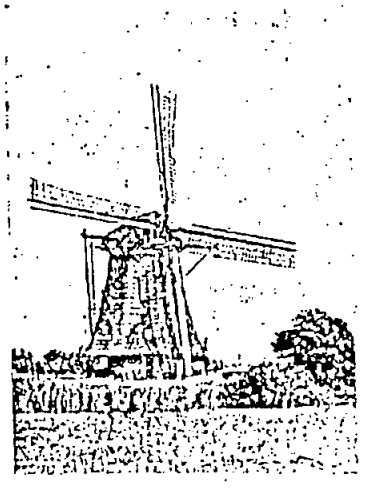
Chapter 1

Introduction

The recent energy crisis has brought about a renewed interest in obtaining energy from sources other than fossil fuels. One of these sources is wind energy; that is, the using of a windmill, to convert wind energy into mechanical energy or other energy forms.

Wind energy has been recognised as a potentially abundant source of clean and renewable mechanical and electrical power. It is estimated that wind power has been utilized for at least 15 centuries, but that more scientific and engineering information concerning the utilization of this source of power has been accumulated during the past few decades than during the early centuries. However, some fundamental principles have been known for at least a few hundred years, as reflected by refinements of earlier designs as Ducth windmills, as shown in Fig.1.1



Wind power becomes essentially obsolete during most of the present century because of the convenience and relatively low cost of electric power, which was brought to the hinterlands via very ambitious programs of rural electrification. It was not until many countries slowly awakened to the prospects of energy shortage and high energy costs that wind power, as a component of solar power, created new interest.

In the late 19th century the familar American multiblade windmill as shown in Fig.1.2 appeared on the scene. Many machines of this type are used in outback areas of the U.S.A. and Australia for pumping water. Such windmills are rugged, reliable and relatively cheap, and the modest energy conversion efficiency is not a serious drawback.

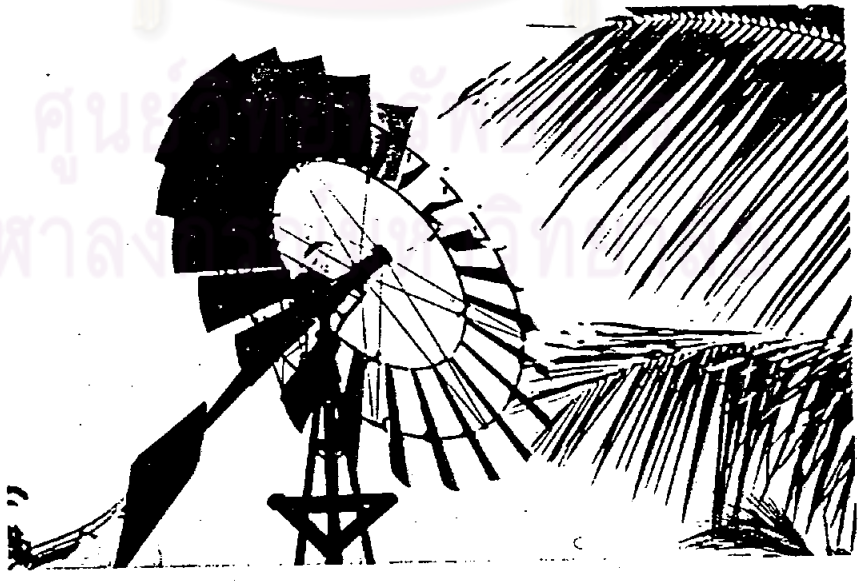


Fig.1.2 Multiblade windmill

Nevertheless, some progress did not occur during the second quarter of this century when wind power, in general, has descended almost to the status of a curiosity. For example,

In Denmark[1,2], during World War II, a total of 18 aerogenerators were constructed in the range of 70 to 90 KW. These supplied direct-current power to the power grids. Another aerogenerator, designed to produce 0.2 MW at wind speed 15 m/s was constructed at Gedser. For this unit, the tower was 26 m high, the blades were 24 m in diameter, as shown in Fig.1.3 and the electric generator located on a horizontally rotating platform atop the tower produced 380 V-AC. Although the unit was shut down in 1968, it still standing until the mid 1970.

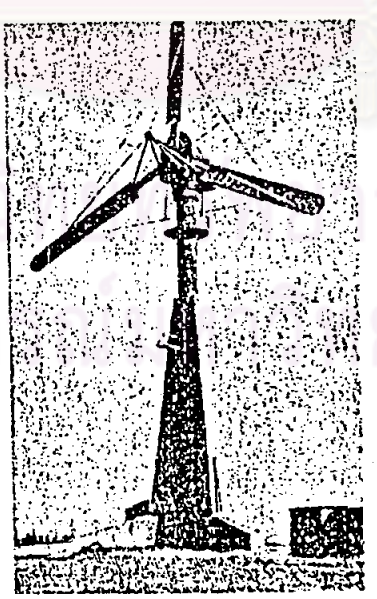


Fig.1.3 Gedser windmill

In U.S.A.[3,4](1974), the National Aeronautics and Space Adminisstration (NASA) commenced construction on an experimental wind turbine generator at the NASA,

Lewis Plum Brook test area. The tower of this unit is 30 m high the rotor is 38 m in diameter, with a planed output of 100 KW as 460 volt, 3 phase, 60 Hz alternating current as shown in Fig.1.4. This machine was given the name Mod 0 by the Energy Research and Development Administration at that time. The unit is now used as a test-bed for advanced aerogenerator components.

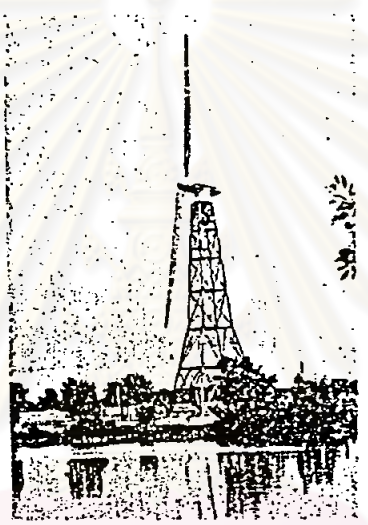


Fig.1.4 Mod 0 windgenerator

Early in the revived interest in aerogenerators in the U.S.A., ERDA concentrated its attention on larger machines. However, in mid 1976, a program was established at the Rocky Flats laboratory to evaluate the performance of many types of small wind machines. As pointed out at that time, whereas the large-wind machine program is one of sequential development, the small-scale program is intended to emphasize parallel development of competing machines. Also, later in the 1970, U.S. energy officials expressed an increasing in the wind-farm concept which involves lower-capacity machines.

1.1 Objective

One of the great virtues of wind energy is its availability in those areas where conventional energy supply is available, then, a windmill system can provide a good and reasonably reliable source of energy. In rural areas, for example, water pumping for irrigation, the windmill is a necessary machine.

The objective of this research is to study the performance of a simple small size, horizontal-axis, low speed windmill which may be adapted for pumping water in rural areas which have low wind velocity. The simplication of construction, especially windmill blades is considered for the limitation of locally available technology.