PLOVDIV UNIVERSITY "PAISII HILENDARSKI"

TECHNICAL COLLEGE OF SMOLYAN

XV International Scientific Conference

RENEWABLE ENERGY & INNOVATIVE TECHNOLOGIES

"RE & IT - 2016"

CONFERENCE PROCEEDINGS
Volume 1

10 – 11 June, 2016
Smolyan, Bulgaria

XV International Scientific Conference
"RE & IT - 2016"
RENEWABLE ENERGY & INNOVATIVE TECHNOLOGIES

MAIN TOPICS

RENEWABLE ENERGY:
- Solar and Hybrid Thermal Systems;
- Solar Photovoltaic Systems;
- Shallow Geothermal Energy Applications;
- Storages with Phase Change Materials (PCM);
- Energy Efficiency;
- Wind Energy.

INNOVATIVE TECHNOLOGIES:
- Mechanical Engineering and Technologies;
- Automobile Engineering and Technologies;
- Tribology;
- Materials Science;
- Electric Power Engineering;
- Electrical Engineering;
- Electronic Engineering and Technologies;
- Computer Engineering and Technologies;
- Communication Networks;
- Telematics;
- Automatics and Control Systems;
- Food Engineering and Technologies;
- Information and Educational Technologies;
- Biotechnologies;
- Innovative technologies in natural, social sciences and humanities;
- Innovative technologies in the science and practice (Section for students and post-graduate students).

Venue
Technical College Smolyan
28 Dicho Petrov – Str.
Hotel Kiparis
3A Bulgaria – Str.
Smolyan

Honorary Chairman:
Prof. Zapryan Kozludzhov, PhD
Rector - Plovdiv University "Paisii Hilendarski"

Chairmen:
- Prof. Nevena Mileva, PhD
  Vice-rector - Plovdiv University "Paisii Hilendarski" Science & project activities, international cooperation;
- Prof. Georgi Mishev, D.Sc;
- Assoc. Prof. Silviya Stoyanova, PhD
  Director of Technical College – Smolyan.

XV International Scientific Conference
Renewable Energy & Innovative Technologies, Conference Proceedings, Volume 1
"RE & IT - 2016"
Edited by Rumen Popov
Publishing House: „Imeon" Sole-owner, 2016
ISBN: 978-619-7180-78-7

15th "International Scientific Conference"
RE & IT - 2016, SMOLYAN - BULGARIA

AP BI-DARRIEUS-1 WIND TURBINE

A.K. YERSHINA, SH. A. YERSHIN, R.K. MANATBAYEV, N.B. KALASSOV, A.A. KUYKABAEVA, A.E. TURSYNBAYEVA

Abstract: *There are a great variety of wind turbine constructions but by their principle of operation they are divided into three main types - sail (Savonius wind power unit), propeller and airfoils (Darrie wind turbine). At present, propeller-type wind-turbines are the most widely spread. They are produced on a commercial level in many countries. Other conditions being equal, the power produced by wind power unit (WPU) is proportional to the area being swept around by a wind wheel. Therefore, Megawatt propeller-type wind turbines have blades with the length of 40 and more meters. Only aircraft works with a highly-qualified personnel and corresponding equipment can produce such long blades of a specific shape. Of high interest have become airfoil wind turbines (Darrie WPU) lately. They are of a simpler construction and have a quite high wind power utilization factor (=0.45). In spite of the fact that this is a good index of WPU efficiency, the workers of al-Farabi Kazakh National University have developed a new version of a wind turbine which allows increasing 1.3-1.6 times the value of this coefficient. This apparatus is named a Bi-Darrie unit. This paper presents the description of a Bi-Darrie unit, the principle of its operation and the possibility of increasing the wind power utilization factor. Also, the results of testing an acting laboratory model in an aerodynamic tunnel and a full-length apparatus are reported. Video films are attached to the paper.*

Key words: *wind power engineering, vertical-axis wind turbine, Darrieus wind turbine*

1. Introduction

There are different types of wind turbines. The simplest of them is the wind turbine of sailing type (Savonius). Its feature is that it can be used with a vertical axis of rotation, as well as horizontal axis of rotation.

At present, wind turbines of propeller type are the most widely spread (see Fig.1). Historically developed traditions, as well as airplane propellers manufacturing techniques well mastered by industry are affected there. The so-called Camomile type also belongs to propeller type of wind turbine with a horizontal axis of rotation.

Recently a number of foreign firms and scientists began to prefer wind turbines of carousel-type with a vertical axis of rotation of the system Darrieus 1-3 (see Fig. 2 and 3). The symmetrical airfoil of NASA is used there for creation of torque (see Fig. 4).

Darrieus wind turbine has 2 diametrically opposite blades (see Fig. 2) (sometimes 3 equidistant from one another) which represent NASA airfoils symmetric toward the chord. These profiles are well approved and aerodynamic characteristics are known for each number 4-6.

The turbine operates due to generation of carrying capacity at operating blades equidistant from the general axis of rotation 7,8. Blades are placed uniformly around the radius r_0 in central vertical shaft of rotation and are connected to it by one of two ways: by matches or "troposkein".

The technique of fixing troposkein is that flat elastic operating wings are bent in the form of onions and both ends are attached to a rotation shaft. During the operation the turbine of the blade get a form of forcibly rotated sagged rope – troposkein (see Fig. 3). The Darrieus apparatus has the following advantages over propeller wind turbines: 1) in the result of vertical-axis rotation of the turbine the wind direction change has no importance; 2) the electrical generator and other equipment are placed at the earth level, that simplifies the machine design of great power,