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HYBRID WIND-GENERATING OSCILLATORY INDUCTIVE EQUIPMENT FOR PRODUCING ELECTRIC CURRENT

IVAN STOYANOV VALKOV

Abstract: *Essential part of electricity, produced by renewable energy sources, originates from wind-generating equipment. In many cases the wind farms are situated in the coastal shelf zone of seas and oceans. Air flows with certain periodicity and sufficient power act in these places, which makes it reasonable to build wind farms there. The construction of the masts of the wind turbines is strong enough to withstand the cyclic loads due to the action of the sea and ocean waves. This paper suggests mounting at the base of the wind turbine mast an inductive installation for producing electricity after the classical Faraday's law – the law of electromagnetic induction.*

Keywords: *renewable energy sources, hybrid system, energy from sea waves*

1. Introduction

In certain geographical locations nature is generous to people, since it provides various options for deploying renewable energy sources to operate simultaneously 1,2,3. Examples are some coastal areas where air flows, causing or accompanying independent excitement of the sea surface (in practice oscillatory motion with enough energy to move a float with a magnet along the axis of an induction coil for electricity generation), act simultaneously and drive wind-generating equipment. From economical point of view it is reasonable to combine some parts of the wind-generating and inductive equipment, which is also the main idea behind the present paper.

2. Equipment structure

The equipment consists of a standard wind generator, whose mast is rigidly fixed to the sea bed. The base of the mast is hollow, cylindrical and punched. This will allow the water level in it to follow the oscillatory motion of the surface of the sea water. A float with a constant magnet will be placed in the cylindrical hollow, where it will perform oscillatory motion in vertical direction. On the outer side of the mast a rigidly fixed winding of electrical conductor will be mounted. The position of the winding will be chosen so that the permanent magnet is in the middle of the width/height/ of the winding at calm water – fig. 1.

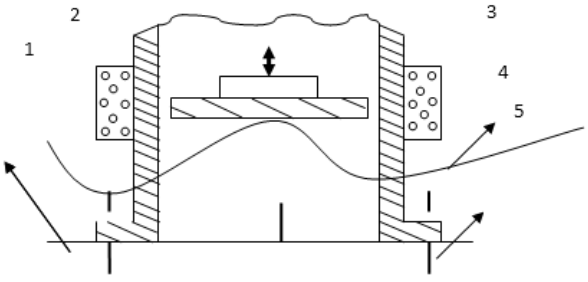

Fig.1 Exemplary scheme of the hybrid system: 1 – mast; 2 – permanent magnet; 3 – float; 4 – winding; 5 – wave; 6 – sea bed

3. Principle of operation

Under the action of the sea waves the float together with the permanent magnet performs reciprocating motion in vertical direction. The motion of the magnet along the axis of the fixed winding leads to a change in the magnetic flux Φ_B through the transverse cross section of the winding, and, as a result, according to Faraday's law, voltage is induced in the winding

$$\varepsilon_i = -\frac{\partial \Phi_B}{\partial t} .$$

Thus obtained, the induced current is brought to the coastal line in an appropriate way for direct or indirect (after certain transformations) consumption.

4. Experimental installation

An experimental installation was realized in order to demonstrate the suggested hybrid system – fig. 2.

The induced voltage was measured by means of the digital measuring device METEX 380 D, equipped with interface RS 232.

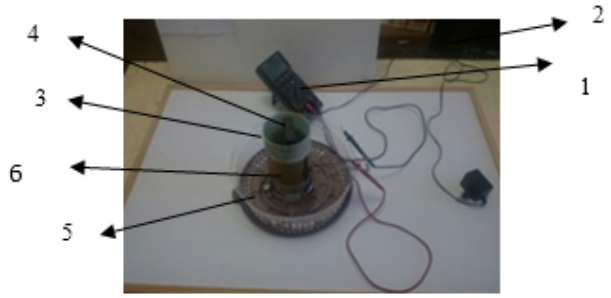

Fig. *2 Experimental installation: 1 – measuring device METEX; 2 – PC; 3 – lower part of the mast; 4 – float with permanent magnet; 5 – water vessel; 6 – inductive winding*

The results from the experiment are shown in Fig. 3 and Fig. 4, illustrating the shape of the induced electric voltage in the inductive winding 6 by oscillatory motion of the water surface – Fig. 2.

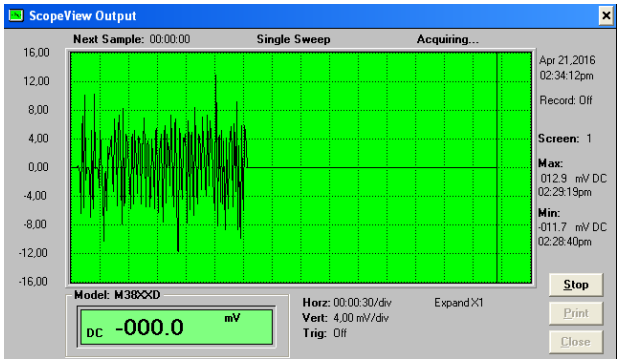

Fig.3 *The shape of the induced electric voltage*

The experiment was carried out using a copper coil with a number of turns n = 100. The coil is mounted on a plastic tube with a diameter of 50 mm. In this tube (playing the role of the mast of the wind generator) is another tube with a diameter of 40mm. It is a closed, isolated and filled with air (plays float). At the top end is attached a cylindrical magnet with a diameter of 45 mm and a height of 25 mm. The simulation of the waves is carried out using a low-speed piston reciprocating pump connected with the water container. The resulting waves have an amplitude of approximately 0 to 4 cm and a repetition rate of 0,1 to 0,2 Hz.

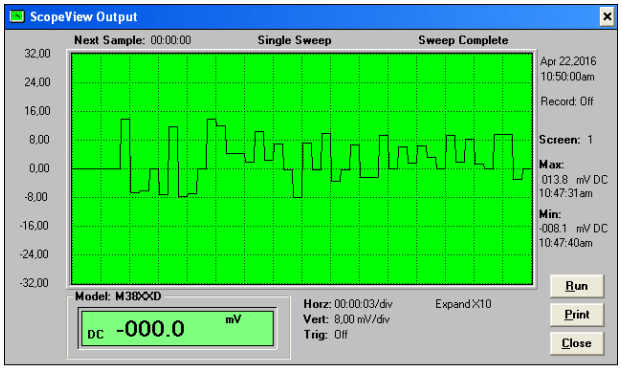

Fig. 4 *The shape of the induced electric voltage (time zoomed)*

5. Conclusions

Construction of hybrid wind-generating inductive equipment for producing electric current from sea and oceanic waves has been proposed. The construction presupposes savings compared to the case when the inductive system is independently built.

The characteristics of the obtained current will depend on the configuration of the winding (diameter, height, number of turns) and the parameters of the permanent magnet.

An experimental installation has been built and tested. The functionality of the oscillatory-inductive system for generating induced current has been confirmed by means of the installation.

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Contact:
Associated Professor
Ivan Stoyanov Valkov
Technical University of Sofia, Plovdiv Branch
E-mail: ivan_v52@yahoo.com