

ECOLOGICAL BOAT USING THE RENEWABLE ENERGIES

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One presents an ecological boat, proper to biosphere reservation Danube Delta in Romania, using the solar energy cached by the photovoltaic cells for the propulsion, as well as the river kinetic energy for the additional loading of the electric accumulators.

One gives details concerning the original design method for the screw, to realize the maximum propulsion force, as well as its location place in the view of the ruder elimination.

At the same time, one presents the design and realization of the hydro-power unit, constituted by an axial hydro turbine, direct coupled with a submersed electric generator endowed with permanent magnets, for the supplementary loading of the electric accumulators while the boat is anchored.

Keywords: Ecological boats. Renewable energies. Electric propulsion.

1. Introduction

In protected natural reservation from all over the world, it is a particularly concerning for using electric propulsion for water transport or ecological tourism.

The diversity of this preoccupations and achievements could offer a rather large palette of products and standard separated services, but there implementing in a coherent ensemble with a well-determined destination, as is the one of the tourist and utilitarian transport in protected hydrographic zones – reservations [1], is submitted to some dysfunctions and difficulties concerning technical and economical optimization. In this order, considering that on the Danube and Danube Delta [2], solar energy and wind energy have a non permanent operation, we can although consider the hydro energy of flow river, even this, is rather reduced (due to the small flow river speed on the flat area: 0,5-2 m/s).

This new solution for ensure the energetic autonomy of ecological boats droved by electric motors, is based on devices who can convert the kinetic energy of flow river in electric energy (submersible micro hydro generators).

For this application we design and achieve a electric boat (catamaran type) with photovoltaic panels (mounted over a boat cover) for extra production of energy, during the sunny day. The submersible electric generator is mounted on

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fore part or pupa part of the boat, the submersible micro hydro generator is direct drive by a small axial hydro turbine who may be shrouded.

Ecological boat, of catamaran type for a better stability (fig 1), with electro-mechanic propulsion, was accomplished during a research project, funded by Romanian Excellence Research Program, in aim to promote the ecological transport, based on the renewable energies. .



Fig. 1. Aspect of the realised ecological boat of catamaran type

2. General technical aspects of ecological boat

The boat is destined for tourist trips and although for goods transport, with a supplementary charge of 450 kg (four persons with luggage). The mass of this boat together with energetically conversions systems, electric propulsion system, rule boat system and adjacent sub-units is 600 kg.

The originality of this selected solution result from joining the two energetic conversion systems (solar and hydraulic), applicable for displacements of ecological boats on rivers with a current flow speed between 1 and 3 m/s. The hydroelectric conversion system is based on submersible micro hydroelectric generator, which is started after is slotted in the water (in submersible position,

with micro turbine positioned in front of the current water), assisted with a manual crane. To be able for hydro energetically conversion in electric energy, with the help of micro-hydro-generator, the ecological boat must be anchorage on the direction of current flow.

The maximum speed displacement is 3 m/s and cruise speed is 1,8 m/s. We itemize the main sub-units of this ecological boat, with following technical characteristics:

- The body of the boat is catamaran type (5 m length, 2,2 width and 2 m high from the deck), with a total drag of the floaters 380 N.
- Storage system of electrical energy: 2-4 accumulators, licked in various series/parallel connection schemas, each at 12V - voltage and 75Ah – capacity.
- Electric propulsion system: alternative current electric motor (brass less – 24 V- voltage, 2,2 kW- maximum power at 3000 rpm – shaft speed, 90A - full current), force electric drive (electronic converter, electric motor speed control), intermediate drive body, propeller.
- Solar conversion system in electric energy: 3 photovoltaic panels, USP 150 model, linked in parallel schema; 24 V c.c. - output voltage, 450 W - maximum power. At output panels is connected with an electronic controller for 24 voltage regulation, useful for recharging the electric accumulators and although for electric utilities of the boat.
- Kinetic energy of river current flow conversion system in electric energy, by submersible electric micro-hydro-generator:
 - Output power of 25W for 1 m/s water current flow speed
 - Output power of 50 W at about. 1,5 m/s - water current flow speed
 - Output power of 70 W at about 1,8 m/s - water current flow maximal speed, obtained during the experimental research. At output electric generator is connected with an electronic controller for 24 V voltage rectifying and regulation, useful for the recharging the electric accumulators and although for electric utilities of the boat.

3. Remarkable performances for the electro-mechanic equipment.

The submersible electric generator, direct coupled with the axial hydraulic turbine and also the electric motor for propeller driving are realised by using of the permanent magnets made from Neodymium-Boron-Iron, disposed on a cylindrical revolve yoke, the fixed coil being the electric stator [3].

The axial hydraulic turbine was realized on the basis of an original method, to extract the maximum mechanical power at his shaft from the kinetic river current energy [4][5][6][7], determining the profile best shape and his optimum settlement angles at different radii, the high performances being verified

by the experimental research in the Hydropower Laboratory “Dorin Pavel” of the Hydraulics and hydraulic Machines Department of Polytechnic University [8].

In the same time, one applied an other original method [9][10], consisting in the maximization of the propulsion axial force unconditioned or reported to the mechanical driving power.

4. Conclusions

The construction of this ecological boat, provided with his electro-mechanical equipment, using the renewable and non-pollutant energies, is suitable to the biosphere reservation Romanian Danube Delta.

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