WAVE MOTION PHYSICS AND ENERGY POTENTIAL

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Contents

Summary

Renewable power of wind waves in oceans, seas, large lakes and storage ponds is a derivative from the power of the sun and the wind. The mean specific power of perturbation of the World oceans is rated at 2.7 W m^{-2}. Traveling substantial distances (hundreds of kilometers), the perturbation accumulates energy. Due to this, the energy becomes naturally concentrated. The mean specific power of wind waves for the countries of the Northern Hemisphere is about 25 kW per 1 m of the wave front. The useful power of wind waves is estimated as 2.7 billion kW.

Existing theories of wave movement allow predicting their behavior only approximately. However this approximation is sufficient for practical analysis of the work processes of wave power installations.

Theoretical description of linear, nonlinear and isolated waves is given. Wave behavior in deep and shallow water as well as near the shore is analyzed. Equations are presented to calculate the energy and power concentrated in different kinds of waves.

Estimations of power resources for the world oceans and for some countries are given.

1. Introduction

Wind waves are charged by solar energy and its derivative - wind energy. There is a general air circulation in the atmosphere. Hot air above the low latitude waters flows up and moves to the polar sector, where it cools, goes down and moves backwards. The shape of the Earth influences this type of circulation and its rotation.

Water masses receive energy from the moving air masses due to friction in the boundary layer. This energy is the higher the more surface is distorted.

Wave parameters that can be measured directly are its height and period. These parameters can be obtained using a wave grapher or can be estimated by sight.

The majority of existing collected information is done by sight. It is known, that the observed height of the wave does not coincide with the mean wave height. Yet this height is close to the wave's height, defined as the mean of one third of the maximum waves heights from the general sequence of wave's heights.

There is no mathematical theory, which can accurately describe this phenomenon; existing theories can only approximate it.

The linear theory of waves, also known as the Ary theory, is used in this paper.

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Biographical Sketch

Nicolai K. Malinin, Professor, Department of nontraditional and renewable energy sources, Moscow Power Engineering Institute (Technical University), Russia

Born 25 November 1938, Moscow

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