Evaluation of Energy Gain of Float Type Wave Energy Converters

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ABSTRACT

The authors are developing a movable body type wave energy converter of the float-counterweight system. This consists of the driving pulley, wire, float and counterweight suspended from idler pulleys and ratchet mechanism. Though it has succeeded in solving the major structural strength problem popular to movable body types, there still remains the unsolved problem in which the floats would slam against adjacent structure(s) by wave load acting horizontally (Hadano, 2011; Koirala, 2009). In order to overcome this problem, we proposed the system which consists of float-counterweight system working in the water chambers aligned along the wave propagation direction so as to make use of the U-shaped oscillation in the chambers to eliminate the horizontal motion of the water around the float(s) (Hadano, 2013; Koirala, 2012). The remaining problem is that the occurrence of the slackening of wire during wave cycle cannot be completely avoided. In order to overcome this problem, we propose a new system in which the wire transmitting the power is wound around the pulleys and the float receiving the wave power is pulled by the wire from both its upper and lower ends to avoid the occurrence of slackening during the wave cycle. This system works in the water chamber(s) mentioned previously. In this paper, we developed the dynamics model for the proposed system. Energy gain has been calculated for realistic wave conditions and compared with the original float-counterweight device. The important differences from the float-counterweight system are that (1) both upward and downward motions of water surface can be utilized without problem, (2) slackening of the wire is almost completely avoided, (3) temporal variations of energy gain and wire tension are effectively suppressed, and (4) for the same time averaged energy gain, the maximum wire tension is fairly lowered.

KEY WORDS: Wire tension; slackening; idler pulleys; buoyancy.

INTRODUCTION

Despite the enormous potential of ocean waves, utilization of wave power on a commercial scale still seems elusive. Several innovative technologies have been proposed which although look promising in principle, have faced many set-backs, not the least of which is the poor