WAVE ENERGY CONVERTER (WEC) M-2

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Model Description

1. Axle

A main element of wave energy converter is an axle, consisted of several solid cylindersconnected one to another by an elastic pipe or by hinged sections, with a wave receivers moving along the cylinders.Converter can be placed on the water surface, or submerged into the depth, where wave parameters are enough for the converter effectiveoperation. For this goal the device has to be anchoredto the sea/ocean bed by two or more ropes that help to place it horizontally at the desired depth. The appliance is placed in the direction of the wave propagation.

The axle is made of nonflexible and antimagnetic material, with the inductors fixed immovably in it.

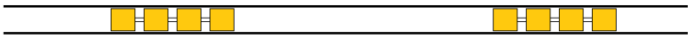

Fig. 1.

The average specific weight of the whole structure is less than water's one, thatmade its floating, while by stretching the rope we can deluge it to the depth where the wave impact on the converter does not exceed the design load limit.

2. Description of the wavereceiver

The wave receiveris made up of a cylindrical pipe,

Fig. 2.

a circular wing perpendicularly fixed on it immovably and

Fig. 3.

a circular magnet or magnets, also fixed on such manner.

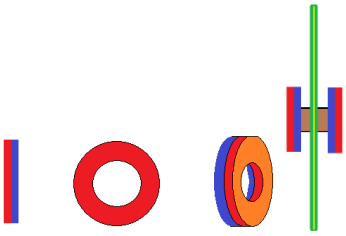

Fig. 4.

The internal diameter of the moving pipe is little bit more than the axle's external diameter. It is fayed on the axle and can freelymove along the latter one.

The loading that created on the wave receiverwing under the impact of the wave current, causes its movement along the axle. It makes freely progressive and reversible motions along the axle. During this moment, the field of circular magnets will cross the inductors, that causing the electromotive force'generating.

The progressive and reversible motionsof the wave receiver is the result of thewave nature, specifically, after every half-phase of the wave period, before its transformation zone- deep water, the horizontal component of water particles circular motion acquires an opposite direction. Thus the forces acting on the axis-aligned, this event we've used in the previous model.

https://www.youtube.com/watch?v=D1u0vjM3cAY

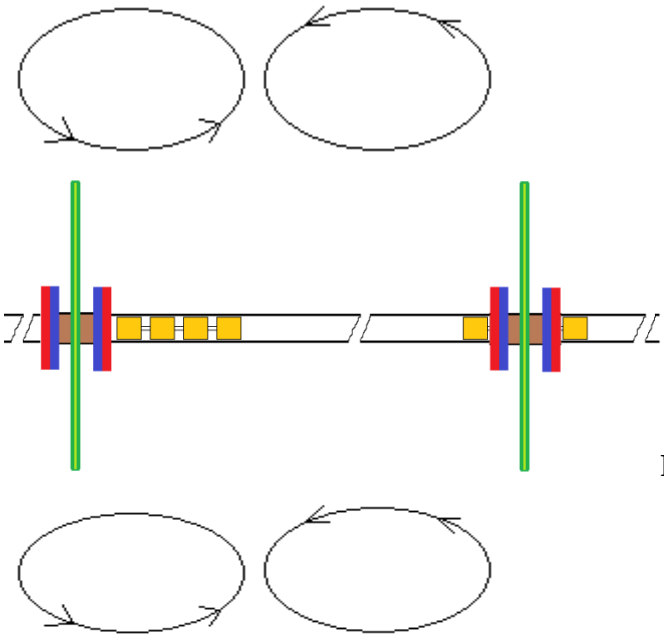

Fig. 5.

In order to maintain the wave receiver in the desired area, i.e. to prevent its leaving the inductors crossing area, a restrictor is necessary. A spring or a circular magnet fixed immovably on the axis can be used as a restrictor, preventing the wave receiver from traveling beyond the desired area.

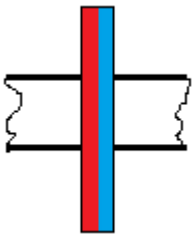

Fig. 6.

The circular magnets, fixed on the wave receiver and inductors, fixed inside the axle jointly creates a linear generator. The structure, as a whole, is a set of linear generators, connected one to another in a series. Owing to the modern techniques, it is not difficult to collect the energy generated by inductors and extract it out of the device.

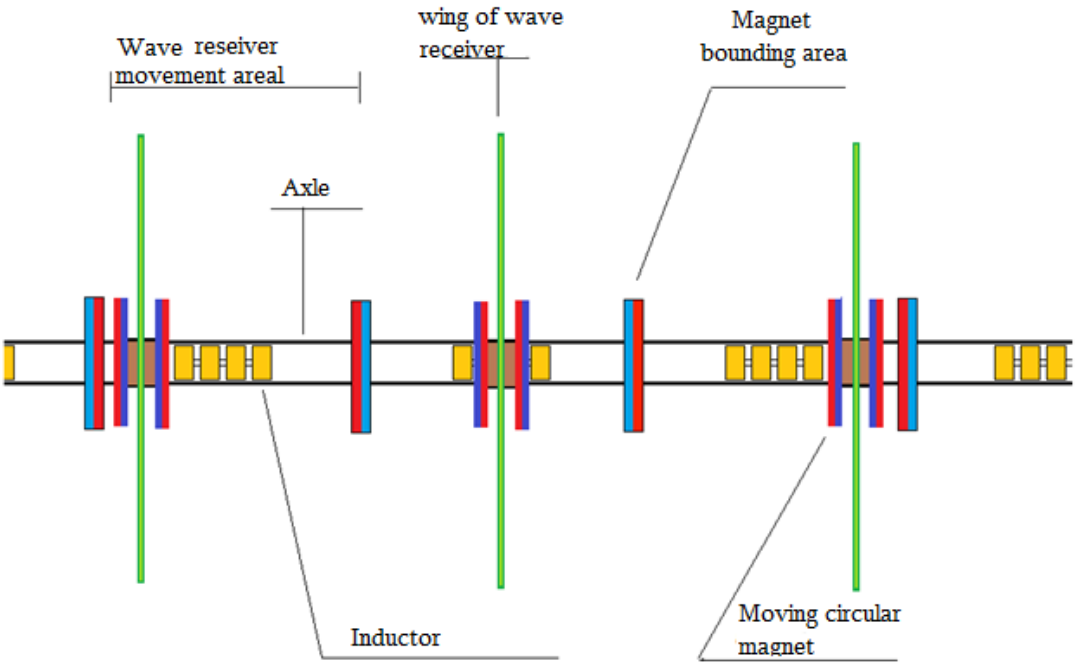

Fig. 7.

Advantages of the appliance over the other models:

Unlike other linear generators used in some wave energy converters, the inductors in our model are placed in the magnetic field significantly improving the stability and reliability of the appliance, as the moving parts need no oiling, lubricating or sealing.

During the wave energy convertersdesigning, like other structures designed to operate in the sea or ocean, the expected maximum load during the strong storms must be considered. During the strong storms, the wave height may exceed the average annual wave height by 10 times, while the energy of the wave may be 100 times more than of an ordinary wave.

Following the requirementsof stability, considering such a load in the structural design makes the appliance heavy and expensive. In addition, often, it is inefficient to use such an appliance for average loads.

The model presented by us is always placed at the depth from the surface where the waves have the parameters necessary for its efficient operation.

It is known that the wave height and the diameter of the circular motion of water particles consequently decrease with the depth. The dependence between the wave height and the depth is roughly as follows: if the depth from the surface increases by arithmetic progression, the height of the wave reduces by geometric one.

The total specific weight of the presented wave energy converter is little bit less than water specific weight, what allows easily submerging it to the desired depth by using the cable tying the appliance to the sea or ocean bed.

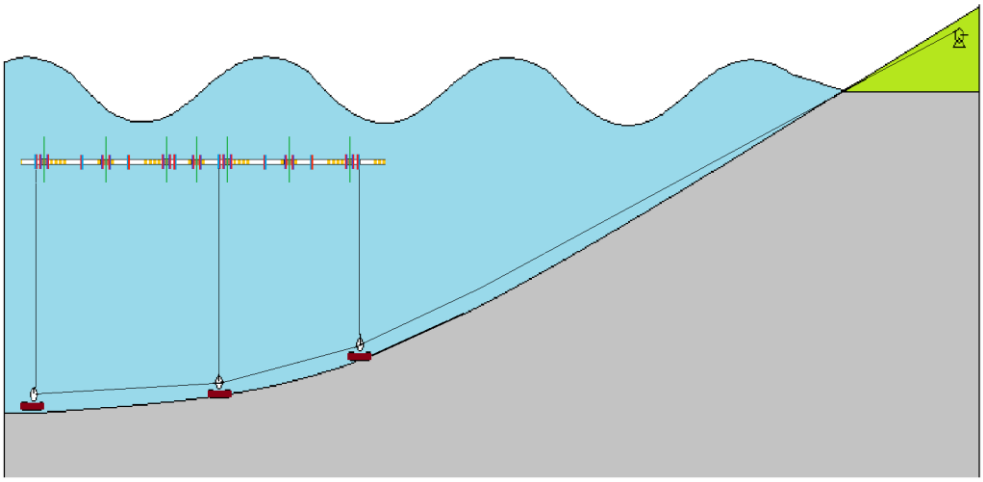

Fig. 8.

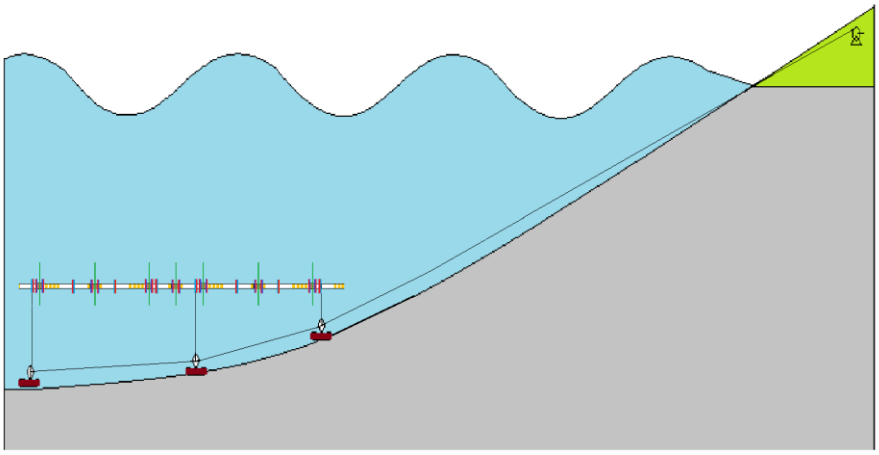

Fig. 9.

We should also like to note that the wind or surface waves are predictable phenomena and the information about the expected wave parameters can be gained 48-72 hours in advance. Therefore, the presented model is free from the requirements for stability in case of loads exceeding the normal loads for many times,making the model advantageous in comparison to other wave energy converters.

The length of the axle (not less than 2 wavelengths) and many wave receivers (at least 8 of them) create the conditions when the forces acting along it are almost balanced in the direction of wave propagation.

These forces are created when the magnetic field crosses the inductors and following the friction of the wave receiver with the axle. However, the mechanical impulse transmitted to the axle by each wave receiver is cancelled out by the impulse transmitted to the axle by another one, placed on a half-wavelength faraway, as it has an opposite direction.

As the longer the axle is and the more the wave receivers are placed on it, as more balanced the axle will be.

Unlike other models trying to extract the energy away from the wave in the first phase, our converter can do it in all phases along the whole axis. As for the axle, actually, it may be very long. There is no factor limiting its length, as it is floated on the water and the forces acting on itare balanced.

It is notable that as we "capture" the wave energy along some wavelengths and their parameters do not change significantly, it is clear that captured ones in the converter area, are restored their energy at the expense of lateral currents.

In our case, the classical formula to calculate the wave energy is useless. It can be used to calculate the energy generated with one drive, while the energy to generate by the appliance can be calculated by multiplying the calculated power of one drive by the number of the wave receivers.
Electrical power may be extracted with a cable, like in case of other models of wave energy converters, such as "Buoy", "Bio", "Pelamis", etc.

All parts of the presented structure serve the function of transforming mechanical energy into electrical one, except ropes anchoring the appliance to the sea bed. Therefore, presumably, the ultimate efficiency of the appliance will be higher than its other analogs.

It should be noted that the most recent model of "Pelamis" weighing 1450 tons, is designed for 750 kW power, i.e. approximately 2 tons of metal is consumed for 1 kW energy.
This indicator will be 15-20 times less with our appliance having positive impact on its price.

We have presented a principally new model with its work capacity and efficiency proved by the laboratory experiments.
Versatile interpretation of the major units of the model designed with this principle is possible.
Such issues as the shape of the wave receiver, parameters of the generator, collection and transmission of the electrical power, automated submerging to the desired depth, combining several structures in one system and other engineering-technological problems will be possible to solve in the process of designing the working models in the future.

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