IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
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Industrial Consultancy & Sponsored Research (IC&SR)

HIGHLY EFFICIENT WAVE ENERGY CONVERTER

IITM Technology Available for Licensing

Problem Statement

- A machine or device to extract energy from ocean waves is called the **Wave Energy Converter (WEC).** A point absorber type WEC includes a floating structure i.e. **a buoy which absorbs energy** from all directions through its movements at or near the water surface. It undergoes heave motion under the action of ocean waves and converts the motion of the buoyant top relative to the base into electrical power.
- In order to extract maximum amount of energy from the ocean waves, **a WEC's natural frequency must match with the frequency of incoming waves** or mathematically speaking, the force acting on the WEC due to waves must be in phase with WEC's velocity. This condition is termed as Resonance.
- However, there are two main hindrances to achieve resonance. **First, ocean waves are low frequency waves** whereas WEC oscillates at a high frequency. Second, **ocean waves are random (irregular) waves** i.e. frequency of ocean waves varies rapidly whereas WEC oscillates at a single frequency. The present invention describes **a point absorber-type WEC** that overcomes some of the drawbacks of the existing converters.

Technology Category/ Market

Category - Energy, Water Treatment
Applications - Power Generation, Water Desalination

Market - The global wave energy converter market is estimated to be valued at **USD 20 million in 2022** and is projected to reach USD 28 million by 2030 growing at a **CAGR of 4.3%.**

Intellectual Property

- IITM IDF Ref. **1617**
- **IN 430483 - Patent Granted**

TRL (Technology Readiness Level)

TRL 3 , Proof of concept (PoC) stage

Research Lab

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Technology

The invention proposes **a Point absorber type Wave Energy Converter (WEC)** and a method for efficient extraction of energy from the ocean waves.

The WEC comprises of **a buoy** that floats on the ocean's surface and **a chamber** that contains the bi-stable configuration of springs and magnets.

The **buoy absorbs energy from all directions** through its movements at or near the water surface and undergoes heave motion under the action of ocean waves.

The chamber further includes a **power take-off mechanism** to convert the heave motion of buoy into electrical output.

Method

- The method includes a **bistable configuration of springs and magnets** to reduce the natural frequency of buoy by countering its hydrostatic stiffness. (Fig.1)
- The bi-stable configuration also **allows the buoy to resonate with the ocean waves** at wide range of frequencies due to which the **buoy's hydrodynamic performance is enhanced** significantly.

Images

Fig. 1

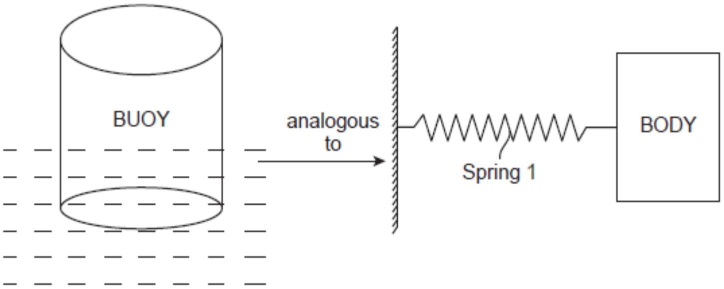

Fig. 1. shows the analogy between a buoy floating in water and a body lying on flat surface connected to a spring having stiffness equal to the hydrostatic stiffness of buoy.

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Key Features/ Experimental Results

- The buoy's performance was analyzed by **conducting experiments in a deep water wave flume design** as shown in Fig. 3A and Fig. 3B.
- An **accelerometer was fixed inside the buoy** to measure its acceleration which was integrated to find the velocity and successively integrated to find the heave response of buoy.
- To perform integration on acceleration data obtained from the accelerometer, **MATLAB software** was used and before integration.
- A **wave probe** was used to measure the height of incoming waves.
- Based on the experimental results, the wave energy converter shows a **maximum capture width ratio up to 79% is attained**.

Fig. 2A

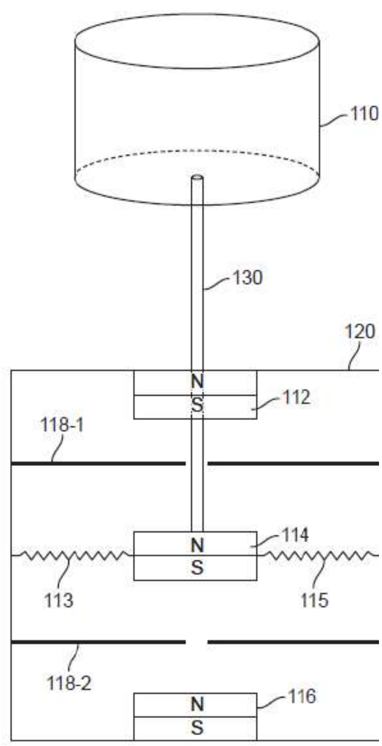

Fig. 2B

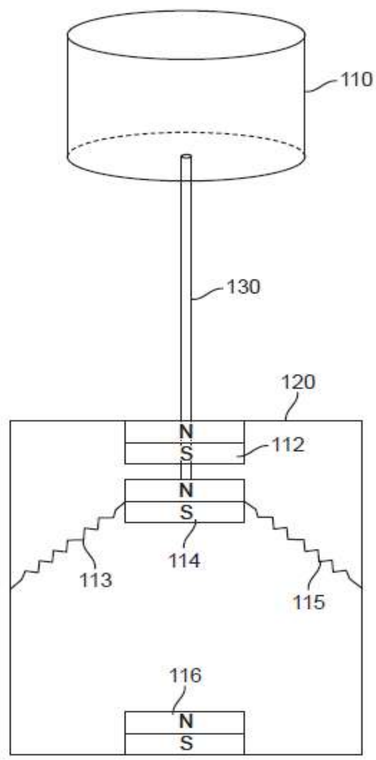

Fig. 3A

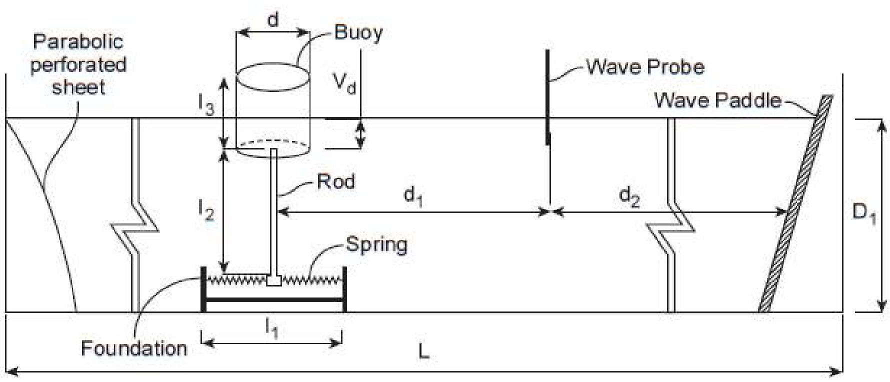

Fig. 3B

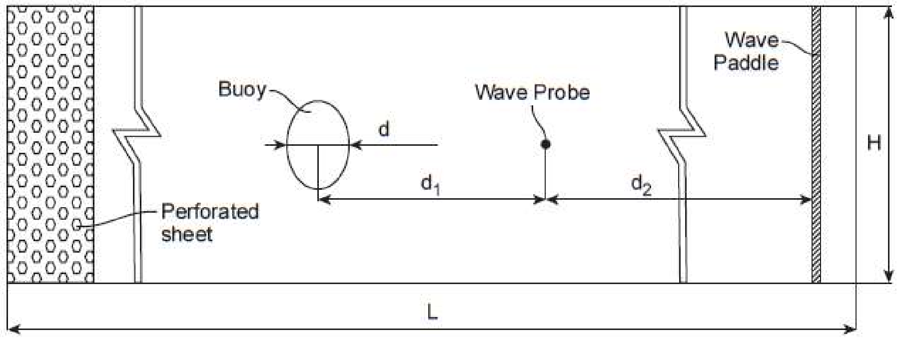

Fig. 2A illustrates the configuration of wave energy conversion system at equilibrium when there is no wave activity.

Fig. 2B illustrates the configuration of wave energy conversion system during wave activity.

Fig. 3A shows the side view of experimental setup for analysis of buoy with bi-stable configuration.

Fig. 3B shows the top view of experimental setup for analysis of buoy with bistable configuration.

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