

2021103827 02 Jul 2021

Australian Government
IP Australia
Innovation Patent Australia

Patent Title: **Wave Energy Converter: New Concept of Low-Cost Wave Energy Converter.**

Name and address of patentees(s):

Dr. Sarbananda Sahoo Dean, School of Commerce and Management, Shri Venkateshwara University, Gajraula, Uttar Pradesh, India.
Dr. Siddharth Suhas Kulkarni 79 Lea Hall Green, Handsworth Wood, Birmingham, B20 2AY.
Nilesh Jagannath Suryavanshi Shree Ramnivas, Kamod Nagar, Indira Nagar, Nasik, Maharashtra, India-422009.
Katam Ganesh Babu (Assistant Professor (ad-hoc)) Mechanical Engineering Department, NIT Andhra, TadepalliGudem, West Godavari District, Andhra Pradesh, India-534101.
Dr. Biplab Das Department of Mechanical Engineering, National Institute of Technology Silchar, Assam-788010, India.
Prof.(Dr.) S. B. Chordiya (Director-SIMMC-Campus) Suryadatta Institute of Management & Mass Communication (SIMMC) Sr. No: 342, Bavdhan, Pune-411021, MH, India.
Mr. Pawan Kumar Singh Vill- Jamuai, Post- Jamuhar, Chunar, Mirzapur-231304, UP, India.
Miss. Pari Nidhi Singh Vill- Jamuai, Post- Jamuhar, Chunar, Mirzapur-231304, UP, India.
Mr. Umakant Dinkar Butkar PhD Scholar Dr. A P J Abdul Kalam University, Indore, MP India. Assistent Professor in Sir Visvesvaraya Institute of Technology, Nashik, MH, India.
Dr. Gaurang Vasantlal Shah B/201, Sushil, Ashok Nagar, Kandivli East Mumbai 400101, India.

Complete Specification: **Australian Government.**

FIELD OF THE INVENTION

[001] Our Invention is related to a Wave Energy Converter: New Concept of Low-Cost Wave Energy Converter.

BACKGROUND OF THE INVENTION

[002] Benefits exploitation waves as a supply of renewable energy offers important benefits over alternative ways of energy generation together with the following: one. ocean waves provide the best energy density among renewable energy sources.

[003] Wave's area unit generated by winds, that successively area unit generated by alternative energy. alternative energy intensity of usually zero.1- 0.3 kW/m² surface is regenerate to a median power flow intensity of 2-3 kW/m² of a vertical plane perpendicular to the direction of wave propagation slightly below the water surface.

[004] Limited negative environmental impact in use. jock details the potential impact Associate in Nursing presents an estimation of the life cycle emissions of a typical nearshore device and also in general, offshore devices have rock bottom potential impact.

[005] The end-stop issue isn't exclusive to devices using a hydraulic device system; it applies to all or any moving body converters with rigid connections to PTOs. the matter arises from the periodical interface prodigious its style travel.

[006] With a hydraulic transfer system, the periodical interface may be connected to linear hydraulic rams accustomed pump fluid to the motor.

[007] The high forces and corresponding energy experienced in extreme conditions can't be suddenly absorbed by touching the top of cylinder stroke, damaging the system. Mitigating this by using high-stroke actuators is compromised by their mass and expense, and their stroke capability won't be exploited most of the time.

[008] Buckling of extended stroke actuators might also be a difficulty, significantly if aspect hundreds area unit gift at most extension.

[009] Methods to mitigate end-stop problems with hydraulic actuators embody specific styles that automatically limit the stroke (Pelamis uses this technique), or area unit supported rotation, during which case a radial piston pump will be utilized (uses this method).

[010] A winch mechanism might even be utilized to drive a rotary pump, and Salter has conjointly examined a rotary machine to be used with the duck WEC. There are a unit alternative styles like the entomb project service heaving buoy that doesn't suffer from the end-stop issue.

[011] The entomb project service conception consists of a protracted tube, open at each end hooked up to a floating buoy. inside the tube could be a piston and also because the

buoy heaves, the water inside the tube forces the piston to maneuver relative to the buoy. because the tube is open at each end, the conception doesn't suffer from the 'end-stop' issue.

OBJECTIVES OF THE INVENTION

1. The objective of the invention is to a Our invention Wave Energy Converter: New Concept of Low-Cost Wave Energy Converter is a Ocean waves are an enormous, for the most part untapped energy resource.
2. The objective of the invention is to a potential for extracting energy from waves is extended. analysis during this space is driven by the necessity to satisfy renewable energy targets, however is comparatively immature compared to alternative renewable energy technologies.
3. The objective of the invention is to a introduces the overall standing of wave energy and evaluates the device varieties that represent current wave energy device (WEC) technology, notably specializing in work being undertaken.
4. The objective of the invention is to a attainable power take-off systems are known, followed by a thought of a number of the management methods to reinforce the potency of purpose absorber-type WECs.
5. The objective of the invention is to a convergence on the most effective technique of extracting energy from the waves and, though previous innovation has typically centered on the construct.
6. The objective of the invention is to a first interface, queries arise regarding however best to optimize the powertrain and also this text concludes with some suggestions of future developments.

SUMMARY OF THE INVENTION

[012] To realize the advantages listed higher than, there are a unit variety of technical challenges that require to be overcome to extend the performance and thence the business aggressiveness of wave power devices within the world energy market.

[013] A significant challenge is that the conversion of the slow (~0.1 Hz), random, and high-force periodic motion into helpful motion to drive a generator with output quality acceptable to the utility network. As waves vary tall and amount, their various power levels vary consequently.

[014] While gross average power levels will be expected ahead, this variable input has got to be regenerate into swish electrical output and thence typically necessitates some form of energy storage system, or alternative means that of compensation like Associate in Nursing array of devices.

[015] The in addition, in offshore locations, wave direction is very variable, and then wave devices ought to align themselves consequently on compliant moorings, or be symmetrical, so as to capture the energy of the wave.

[016] The directions of waves close to the shore will be for the most part determined ahead thanks to the natural phenomena of refraction and reflection and also the challenge of expeditiously capturing this irregular motion conjointly has a bearing on the planning of the device.

[017] To work expeditiously, the device and corresponding systems ought to be rated for the foremost common wave power levels. round the island and also the western coasts of Europe, the foremost common offshore waves area unit around 30–70 kW/m.

[018] However, the device conjointly has got to face up to extreme wave conditions that occur terribly seldom, however might have power levels in far more than 2000 kW/m.

[019] Not solely will this create tough structural engineering challenges, however it conjointly presents one among the economic challenges because the traditional output of the device (and thence the revenue) area unit made by the foremost ordinarily occurring waves.

[020] nevertheless the opportunity cost of the device construction is driven by a requirement to face up to the high power level of the intense, nevertheless sporadic, waves. There also are style challenges so as to mitigate the extremely corrosive surroundings of devices operational at the water surface.

[021] The principle of the periodical water column is illustrated in Fig. 1, during this example to be used in conjunction with a hard and fast structure (e.g., breakwater).

[022] The functioning of the periodical water columns (OWCs) is somewhat like that of a turbine, being supported the principle of wave evoked air pressurization.

[023] The device is ready upon a closed air chamber, that is placed higher than the water. The passage of waves changes the water level inside the closed housing and also the rising and falling water level will increase.

[024] The atmospheric pressure inside the housing introducing a bifacial air flow. By inserting a rotary engine on high of this chamber air can pass in and out of it with the dynamic atmospheric pressure levels.

BRIEF DESCRIPTION OF THE DIAGRAM

Fig.1: Schematic Diagram of a New Concept WEC.

FIG.2: New Concept of Low-Cost Wave Energy Converter process.

DESCRIPTION OF THE INVENTION

Working Principle:

[025] This new plan could be a Positive Displacement sort pump that works on the principle of movement of the piston in forwarding and backward directions.

[026] during this system piston moves per the motion of the plate. Here, the plate acts as Associate in Nursing energy absorbent upon that ocean wave strikes usually.

[027] The plate moves within the surge direction against the 2 compressions springs and returns to its original position because of spring action. during this method, the plate takes to and fro motion.

[028] The plate connects to the piston through the connecting rod. The piston moves with the movement of the plate during a closed-fitting cylinder.

Two valves are hooked up to the cylinder:

- 1) suction valve
- 2) delivery valve.

[029] The valves are unidirectional valves that permit the water to flow in one direction solely. because of the piston's backward motion, the pressure decrease within the cylinder is smaller than the air pressure.

[030] Therefore, water enters the cylinder through a suction valve from the ocean. because of the piston's advancement, the pressure enhanced within the cylinder, that is bigger than the air pressure.

[031] Therefore, water discharge through the delivery valve from the cylinder to a definite height. The power take-off (PTO) system of a wave energy device contains a direct impact on the opportunity cost of a project by sometimes accounting for between twenty and half-hour of the investment.

[032] The economic viability, potency and complexity of a wave energy device depends for the most part on its PTO system.

[034] Maintenance confounded could be a demanding and high-priced task; high responsibility and sturdiness of all elements of the PTO system are thus needed.

[035] This can be technically difficult for systems exposed to the cruel marine surroundings, particularly systems that incorporates several moving components that are exposed to corrosion and fouling. many widespread PTO systems are reviewed by Ahamed et al. from that the outline below is extracted.

[036] Oscillating water column wave converters (OWC) typically use the antecedently delineate Well's rotary engine as PTO system.

[037] These turbines are vulnerable because of the comparatively sizable number of moving components. Overtopping devices are typically equipped with hydro turbines for power take-off. standard hydro turbines need for top potency additional head and flow than provided by overtopping ocean waves.

[038] Wave engrossing devices use hydraulic motor systems or direct mechanical or electrical drive PTO systems. Hydraulic motor-based PTO systems are fitted to changing

the low-speed periodical motion into energy.

[039] However, the hydraulic motor-based PTO system consists of the many mechanicals moving components and because of compression and decompression of the fluid there's a risk of hydraulic oil outpouring.

[040] Direct mechanical drive uses linear-to-rotary conversion systems while not gas or hydraulic systems.

The following are the salient conclusion drawn from the testing of the prototype:

1. Wave forces act on the plate and respond within the surge direction.
2. Piston moves within the surge direction and returns to its original position because of spring action.
3. because of the piston's motion during a closed fitting cylinder, pressure variation takes place within the cylinder and energy transformation happens.
4. Discharge bit by bit will increase so decreases with the rise of your time amount.
5. Discharge bit by bit will increase so decreases with the rise of wave precipitousness.
6. Discharge will increase with the increasing motion of the energy absorbent.

[041] Fig:1-shows the schematic diagram of a brand-new construct WEC. It consists of a skinny rectangular plate, piston, cylinder, suction and delivery valve, and 2 compression springs the plate's initial position is and it moves to position B because of ocean wave force and returns to position.

[042] A because of the spring action. 2 valves are hooked up to the cylinder:

- 1) suction valve
- 2) delivery valve. The valves are unidirectional valves that permit the water to flow in one direction solely. because of the piston's backward motion, the pressure decrease within the cylinder is smaller than the air pressure.

[043] Therefore, water enters the cylinder through a suction valve from the ocean. because of the piston's advancement, the pressure enhanced within the cylinder, that is bigger than the air pressure. Therefore, water discharge through the delivery valve from the cylinder to a definite height.

[044] The management of the motor capability may well be supported measured or expected ocean states round the WEC, or fluid flow measurements among the system. in addition, a suffocation valve might even be wont to management the flow to the motor.

[045] Accumulators are enclosed within the circuit to supply energy storage and to keep up constant flow to the hydraulic motor.

[056] additionally, the nonaggressive accumulator provides a tiny low boost pressure to cut back the danger of cavitation on the nonaggressive facet.