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A New Plan for Marine Green Energy System; Gravity Buoyancy System in Deep Waters

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Abstract

The present study is a modern design to generate electric energy by buoyancy gravity, which has been described in details. The design is a backup system beside other modern systems of energy generation such as wind, tide, solar energy, and sea waves. The system could be considered as an efficient unit for energy generation. Gravity Buoyancy (GB) method would be able to generate electric energy through using deep waters of sea, wells, or lakes. To estimate and prove the system, a small sample would be made in laboratory and its characteristics would be presented in the study.

Keywords: Green energy, new energy, electric energy, gravity buoyancy, diving

Introduction

The current system includes some components such as buoyant volume, ballast tank, and two vertical rods for vertical ascent and descent. Several equipments have been also provided for diving such as high pressure air system and solenoid valves.

Buoyancy volume would have negative buoyancy while diving and would have positive buoyancy while surfacing. Vertical movements of the volume would lead to rotation of 2 cylindrical devices, which may finally lead to rotation of electric generator. The method is significantly efficient, comparing to other systems, since is independent from geographical location and weather conditions. The more the depth of water is, the more efficient the system would be. The present study has presented a background of theoretical studies in this regard and applying marine green energy generation system.

New green energy generation method would be vital for human's future life. Related studies to this issue have had many investments in this regard, since they are significantly important in energy generation process. According to "energy conservation" principle, "energy neither bears, nor diminishes, but converts to other types of energy". Some energy resources are free in natural environment such as wind, waves, solar energy, etc. new methods for energy generation are focused on these free energy sources.

Methodology

The present study has applied an innovative method, which is different from other previous methods. The main advantages of the proposed method are its independency from weather variations and its dependency on water depth. The proposed method applies buoyancy energy, which is existed constantly in the natural environment. Concepts of the method include diving by ascent buoyancy and surfacing by descent gravity buoyancy. On the other hand, if the system includes negative buoyancy, it would be dived and if includes positive buoyancy, it would be surfaced.

Discussion and Results

Buoyancy force is able to be produced in deep seas or water bowl and includes many advantages. More depth of water can lead to more continuity in energy generation. Hence, for more efficiency of the system, water should be deeper. The deep water can be a deep well in a desert far from sea. Amount of positive or negative buoyancy can be provided by ballast tank and is an important issue for movement velocity. Water inside the ballast tank can be drained by high pressure air. The system includes some high pressure air containers.

To recharge high pressure air capsules, another energy resource should be applied for compressor operation. The energy would be able to be provided through other new green energies. Hence, GB system can be considered as a backup for other green energies. However, other green energy systems can't work sometimes because of weather limitations; the gravity buoyancy system can be applied. The GB system used to be charged by wide energy range of other green energies. On the other hand, GB system can be a device for energy concentration like batteries; although, the system includes more advantages than batteries, since batteries are heavy, include low energy density, and are weak in wet places.

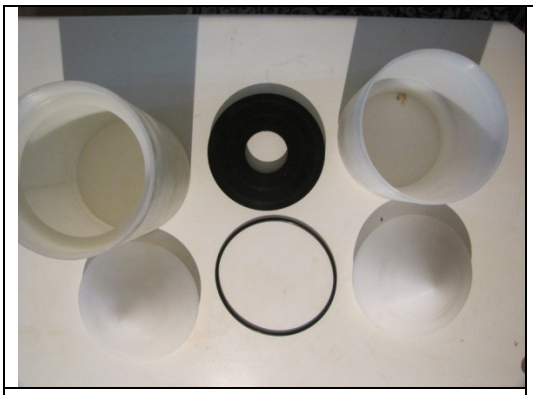
Operation and Related Devices to GB System

Operation of GB system is significantly similar to submarine; although, its movements are just vertical and limited to 2 rods. In fact, GB is a watertight system with high pressure air capsule and a ballast tank. The hull has been connected to 2 gear wheels by a fastened rope. A wheel has been fixed at the bottom of the sea, and other one has been placed above the sea. Both wheels have been designed in vertical form. Second gear wheel includes a chassis, which connects wheels axis to axis of electric generator. Movement of main hull would lead to rotation of wheels and generator. Rotation of generator would also lead to electric energy generation. A small sample of GB system has been made in laboratory and has been tested in a conventional pool with depth about 3m. Figure1 shows several parts and components of the GB system as follows: 1) upper wheel 2) main hull 3) lower wheel 4) generator

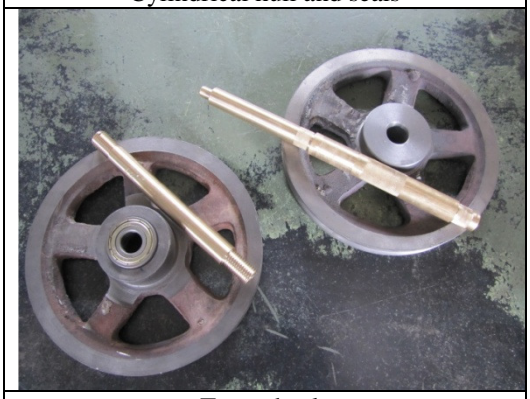
Other parts of the system are also as follows:

a) A conical cylindrical main hull for reduction of hydrodynamic resistance. The hull is fully watertight
b) High pressure air capsule for injection of high pressure air into the ballast tank
c) Ballast tank for surfacing and submerging
d) Installations and piping for high pressure air system; vent piping; water transfer piping
e) Solenoid valves for opening and closing valves
f) Electronic board for controlling valves and automatic controlling of operation

Figure 1: General arrangement and parts of GB system

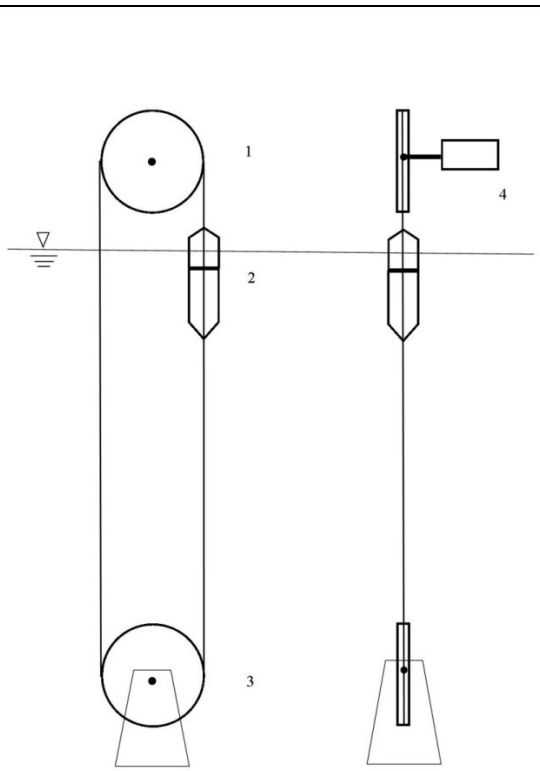


Cylindrical hull and seals



Two wheels

Components inside the hull



1-upper wheel 2-main hull
3-lower wheel 4-generator

High pressure air system

Internal Arrangement of Main Hull

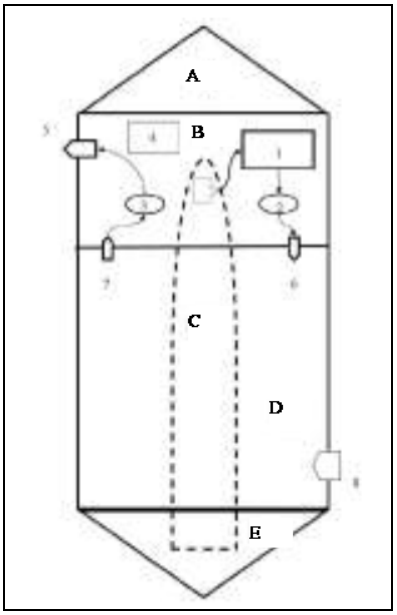
All components have been placed inside the main hull. Upper and lower parts of cylinder have been connected to the rope. Main components of the hull have been presented in figure2.

Main components inside the hull are as follows:

a) Upper conical components for reduction of hydrodynamic resistance
b) Watertight component for arrangement of installations, devices, and electronic board
c) High pressure air capsule
d) Ballast tank
e) Lower conical components for reduction of hydrodynamic resistance
    1) Flux control valve
    2) 2,3) solenoid valves

3) electronic components
4) vent outlet
5) inlet of high pressure air to ballast tank
6) outlet of high pressure air to ballast tank
7) inlet and outlet of ballast water

Figure 2: Arrangement inside the main hull



Dimensions of Sample

Main dimensions of made sample have been presented in figure3. Total length of hull has been 42cm and its total height has been 1.8m. The small scale GB system could generate about 30w electric energy. Other parameters are as follows:

L_1 = *length of ballast tank* = 0.2 *m.*
L_2 = *length of watertight part* = 0.14 *m*
L_3 = *length of conical part* = 0.08 *m*
D_1 = *outer diameter of cylinder* = 0.17 *m*
D_2 = *inner diameter of cylinder* = 0.155*m*
D_k = *diameter of high pressure air capsule* = 0.07 *m*
d = *wheel diameter* = 0.2 *m*
h= *distance between upper and lower wheels* = 1.8 *m*

Calculations of sample

Calculations and parameters' measurements are as follows:

Here, two conditions have been considered as follows: condition A: while surfacing with 1.5kg positive buoyancy; and condition B: while diving with 1.5kg negative buoyancy. Stepwise and detailed calculations are as follows:

$V_{tot} = V_1 + 2V_2$

$$V_{tot} = \frac{\pi}{4} D_1^2(L_1 + L_2) + 2(\frac{1}{3} \text{x } \frac{\pi}{4} D_1^2 L_3)$$

$V_{tot} = 8.923 \text{ x } 10^{-3}\ m^3 = 8.923\ lit$

$V_{ballast} = \frac{\pi}{4}(D_2^2 - D_k^2)L_1$

$V_{ballast} = \frac{\pi}{4}(0.155^2 - 0.07^2)$ x 0.2

$V_{ballast} = 3.002$ x 10^{-3} $m^3 = 3.002$ *lit*

$V = V_{tot} - \frac{1}{2} V_{ballast} = 8.92 - 0.5$ x 3 = 7.42 *lit*

$\Rightarrow max\ \Delta = 7.42$ *kg*

Net vertical force is:

$\sum F_y = F - F_d = mg - F_d$

$\sum F_y = (1.5$ X $10) - 50\%\ (1.5$ X $10) = 7.5$ *N*

Torque in wheels and generator shaft is:

$D_{polli} = 0.2\ m \Rightarrow R_{polli} = 0.1\ m$

$T_{polli} = F.R = 0.75\ N.m$

$T_{shft} = 0.75\ N.m$

Ultimate velocity in diving and surfacing estimates is as follow:

$F_y = 7.5\ N$

$F_y = ma_y \quad a_y \quad \frac{7.5}{7.4} \quad 1.01 \quad m/s^2$

$V^2 = V_0^2 = 2a_y h$

$V = \sqrt{2a_y h} = \sqrt{2 \times 1.01 \times 1.8} = 1.9 \quad m/s$

$R_e = \frac{V.L}{u} = \frac{1.9 \times 0.5}{10^{-6}} = 950000 > 10^3$

C_{form} 0.2

$C_f = 0.004$

$A_{proj} = \frac{\pi.D_1^2}{4} = 0.0226\ m^2$

$A_{tot} = \pi.\ D_1\ (L_1 + L_2 + 2L_3)$

$A_{tot} = \pi \times 0.17(0.2 + 0.14 + 2 \times 0.08) = 0.2669\ m^2$

$F = \frac{1}{2} pC_D V^2 A$

$F_{form} = \frac{1}{2} pC_{form}\ V^2\ A_{proj} = 8.158\ N$

$F_f = \frac{1}{2} pC_f V^2 A_{tot} = 1.927\ N$

$R_{tot} = R_f + R_{form} = 10.08\ N$

Estimations for rpm of wheel and generator and related power are as follows:

$V = cte = 1.9\ ^m/_s$

$h = V.t \Rightarrow t = \frac{h}{V} = \frac{1.8}{1.9} = 0.94\ s$

$h = n.\pi.d$

$n = \frac{h}{\pi.d} = \frac{1.8}{3.14 \times 0.2} = 2.86\ \ Rpm$

$\frac{n}{t} = \frac{Rpm}{60} \quad Rpm_{\ shft} \quad \frac{2.86 \times 60}{0.94} \quad 182.95\ rpm$

$T_{shft} = 0.75\ N.m\ Rpm_{shft} = 182.95\ rpm$

$$P_{shft} = T.\omega = T.\ \frac{2\pi.Rpm}{60} = 14.3\ W$$

$$P_{top} = 2 \text{ x } 14.3 = 28.6\ W$$

Conclusion

Gravity buoyancy (GB) marine green energy system is a new and efficient method for energy conservation, along with other green energy systems. The present study has presented some simple calculations to estimate power of a sample in laboratory. There are several parameters in designing such system; although, some of them are more efficient than other to achieve high efficiency and energy. The mentioned parameters are as follows: depth of water and volume of ballast tank, which effects of their changes and variations on energy generation have been evaluated.

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