

# Power Generation using Gravity and Bouyancy Force

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**Abstract-** In recent times due to effects of pollution and global warming there is a need for generating power from renewable sources. The reason for generating power using gravity is that it is available all over the Earth, abundant and consistent too. In this project we designed a methodology wherein gravitational energy is further amplified in terms of its magnitude by using perpetual motion mechanism and hence can be successfully transformed into usable electrical energy. The basic concept of a gravity power generating mechanism is simple.

Perpetual motion describes "motion that continues indefinitely without any external source of energy impossible in practice because of friction. It can also be described as "the motion of a hypothetical machine which, once activated, would run forever unless subjected to an external force or to wear". There is a scientific consensus that perpetual motion in an isolated system would violate the first and/or second law of thermodynamics.

Cases of apparent perpetual motion can exist in nature, but either is not truly perpetual or cannot be used to do work without changing the nature of the motion. For example, the motion of a planet around its star may appear "perpetual," but interplanetary space is not completely frictionless, so planets' orbital motion is very gradually slowed over time. The fly-by of a space probe past a planet can be used to speed up the probe but in doing so alters the motion and reduces the energy of the planet in its orbit around the Sun. The flow of current in a superconducting loop can be used as an energy storage medium, but just as with a battery, using it to power a device will remove the equivalent amount of energy from the current in the loop.

Machines which extract energy from seemingly perpetual sources—such as ocean currents—are capable of moving "perpetually" (for as long as that energy source itself endures), but they are not considered to be perpetual motion machines because they are consuming energy from an external source and are not isolated systems (in reality, no system can ever be a fully isolated system). Similarly, machines which comply with both laws of thermodynamics but access energy from obscure sources are sometimes referred to as perpetual motion machines, although they also do not meet the standard criteria for the name.

Despite the fact that successful isolated system perpetual motion devices are physically impossible in terms of the current understanding of the laws of physics, the pursuit of perpetual motion remains popular.

There are many ways to convert gravitational energy into electrical energy. Gravia lamp is one of the mechanisms.

## 1. INTRODUCTION

The sole concept of the project is based on power generation using gravity and buoyancy force. There are the two forces that enable rotation of the setup which directly supports the rotation of the dynamo to generate power. The main concept in this project is rotation of the bowl if there is no rotation there will be no power generation.

Now the use of gravity is done in following way. A rod is passed through the centre of the hollow sphere such that it is completely symmetrical from all view. This is done to ensure that the sphere is dynamically balanced along the centre rod passing through the centre axis of sphere. Now a mass is attached to the centre rod with a hinge joint and metal strip away from the centre rod which is free to rotate along the centre rod. The mass is locked at the centre of the rod with a hollow pipe on both side of the mass as covering on the centre rod.

Now we attach a float along with the mass in such a way that when the sphere is filled half with liquid the mass does not sink inside and floats on it. As the mass floats on the liquid when we look at the front view of setup the mass on right side of sphere is greater than the mass of sphere on left side. This creates the mass difference and causes imbalance in the system. This imbalance as created above due to mass difference results in difference of gravitational force and thereby the gravitational torque acting on the setup. Thus, the power is generated due to gravitational force.

Secondly, the mass in right hemisphere remains due to the buoyancy force applied by the float on the mass. Thus, there is use of both gravity as well as buoyancy in the setup to cause rotation. It is these two primary forces which are solely responsible for setup to run.

Due to mass difference in the setup the right part of the setup tries to come down and the light part moves upward to reduce the setup's net potential energy. But this never achieved as there will be never balance of force in the system, due to which the bowl keeps on rotating.

But as we have a resistive environment there are many factors which can be considered which could oppose the rotation of the system and ultimately become the cause of the bowl's retarded motion, which finally comes to a halt

after certain time. Factors responsible for this are quite obvious such as Drag force by air, fluid present in the bowl as well as the frictional force acting on the hinges and other movable joints ,etc.

## 2. DETAILED PROBLEM DESCRIPTION

The main components of the setup include:

- 1)Hollow spherical glass bowl
- 2)Stainless steel rod (cross-sectional diameter 10mm)
- 3)Weight and float setup
- 4)Bearings
- 5)Wooden stand

Figure 1 shows a spherical hollow bowl. This bowl is symmetrical in shape and is made of glass. A hole is drilled at lower base of the sphere to pass the rod through the centre of the sphere. The rod passes exactly through the centre axis of the spherical bowl so that when it rotates it does so completely in balance and there is no difference in mass from the centre axis of the bowl to the point on the surface of the spherical bowl in all the directions.

The rod is bolted to the bowl with intermediate rubber plugs so that it prevents leakage of fluid through the openings and is sealed firmly.

The lower part of the sphere is bolted and sealed while the upper part is sealed with a rubber sheet between the bowl parapet and the disc. The disc is circular and is made of acrylic. The disc is bolted with the bowl parapeted at equal intervals along the circumference of the disc. There is also a centre hole in the disc to pass the other end of the rod. The rod over here is also bolted with the circular disc with rubber plugs in between to make it leak proof. The most appropriate volume of water to be filled will be half the volume of bowl. It is because this enables the weight to remain exactly at centre. If the bowl is filled with liquid greater than half volume of the spherical bowl the weight would rise to a higher level which adversely affect the distance of the weight from the centre of the bowl thus would reduce the moment created by the weight in the direction of the rotation of the bowl .Thus will reduce the constant rotation speed of the bowl.

Now there is an arrangement on the centre rod so that there is an imbalance created in the setup. This arrangement is explained as follows. A hollow pipe of diameter slightly greater than the diameter of the rod is taken so that it is free to rotate on the rod. Now this pipe is cut into three sections. These three sections are shown as a, b, c in the figure. The sections a, c just acts as support for the section b so that it remains in the centre of the bowl. The section b has a metal trip fixed to it which carries a weight and a floating ball which would float at the opposite end of the strip when it is fixed with the hollow pipe. The solid rod is passed through

the sections a, b, c such that the section b lies in the middle part with a and c at its either ends as supports.

The whole arrangement consisting of the centre rod and three sections is placed inside the spherical bowl with ends of the rod coming out of the sphere from both entrances of the sphere. Now the outward extensions of the rod coming out of the sphere on either sides are mounted on the wooden stand with ball bearings for free rotation of the entire setup.

The wooden stand is bulky and rigid so that when the bowl rotates there is least moment created. Because as greater is the moment the greater is the chance of affecting the rotation of the bowl, this will reduce the time of rotation of bowl. Thus the complete setup is ready for the experiment.

Now after giving a single push the bowl starts to rotate in the direction of the applied torque. This rotation occurs in the direction of the extra force on the right side of the sphere.

Initially, the bowl has zero velocity. There is difference in mass in the two sections but no limiting torque to overcome the inertia of the bowl and rod. So to overcome that inertia of bowl and rod there is a certain amount of initial energy required to set the bowl to rotate.

Thus a torque is applied tangentially to the the surface of bowl which will overcome the moment of inertia of the spherical bowl and the rod. As the bowl starts rotating there is increment in angular velocity of the bowl and there is increment in height of the water level on the left side and decrement in height of the level of water on the right side.

Now since water is fluid in nature it cannot remain permanently in this position and hence tries to gain its original configuration with respect to the bowl. Now to achieve this it has to move in direction opposite to that of the motion of the bowl. This induces a drag force constituting a drag torque aimed at retarding the growing angular velocity of the bowl. At a certain critical time this negative angular acceleration produced by the drag torque becomes equal to that of the bowl. It is at this moment that the bowl rotates further with a constant angular velocity. Now as the bowl rotates with constant angular velocity this suggests no angular acceleration acting on the components inside the bowl which implies zero resistance from inner components and hence supporting uniform angular motion of the bowl thereafter.

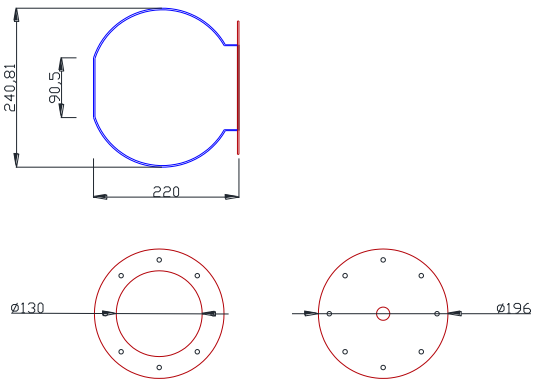


Fig.1. Detailed Diagram Of Bowl

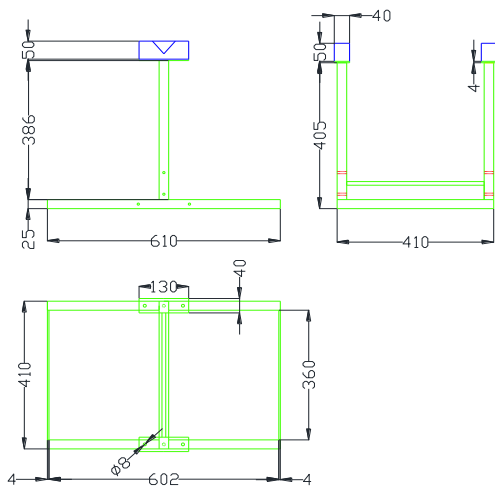


Fig.2. Detailed Diagram Of Stand

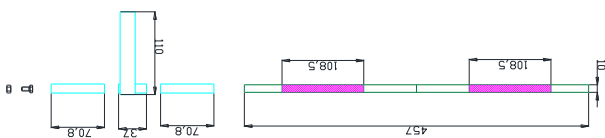


Fig.3. Detailed Diagram Of Rod Pipe Weight And Float Arrangement.

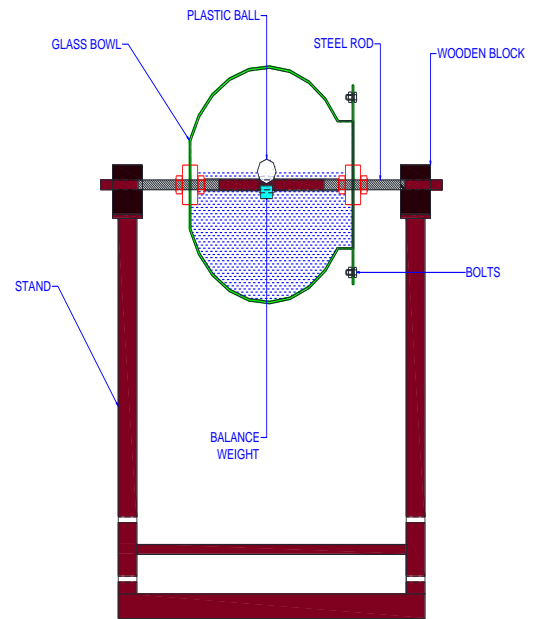


Fig.4. Detailed Diagram Of Complete Setup

### 3. MATERIAL OF CONSTRUCTION

#### 3.1 Mechanical Components:

1. Fish bowl(Glass Sphere)
2. Weight(100gms)
3. Iron Rod (10 mm diameter)
4. Alluminium Hollow pipe(Diameter 12mm)
5. Bearings
6. Angle Section Rod for support stand
7. Palstic Ball as a float
8. Rubber plugs
9. Nuts and Bolts
10. Acrylic Circular Disc

#### 3.2 permanent Magnet Dc Generator:

##### Specifications:

- Voltage: 6.8 -7.4V
- Current: 0.2-0.5A
- Gears: Sintered type
- Gear ratio: 1:50
- Speed: 50-100 rpm

#### 3.3 battery

##### Specifications:

- Type: Valve Regulated (MF) rechargeable battery
- Specifications: 6V 4.5AH
- Max initial current: 1.125A
- Voltage regulation: 250C32
- Stand by use: 6.7 – 6.9 V
- Cyclic use: 7.05 – 7.2 V
- A 6V Battery is sufficient to charge the selected PMDC Generator.

### 3.4 Electric Circuit Component

Components	Quantity	Specification
Zener Diode	1	3.1V
Transistors	2	0.6V
Resistors	3	10KΩ,200KΩ,100KΩ
Capacitor	1	20Mf
LED	1	3.6V(blue LED)

### 4. DETAILED DESIGN

R = Radius of the bowl

ρ = Density of fluid

Ω = Solid angle

M<sub>w</sub> = Mass of water displaced

M = Mass of weight

τ = Applied torque (variable)

τ<sub>d</sub> = Torque generated by drag force

I<sub>1</sub> = Moment of Inertia of bowl

I<sub>2</sub> = Moment of Inertia of Water

M<sub>1</sub> = Mass of Bowl

M<sub>2</sub> = Mass of Water filled

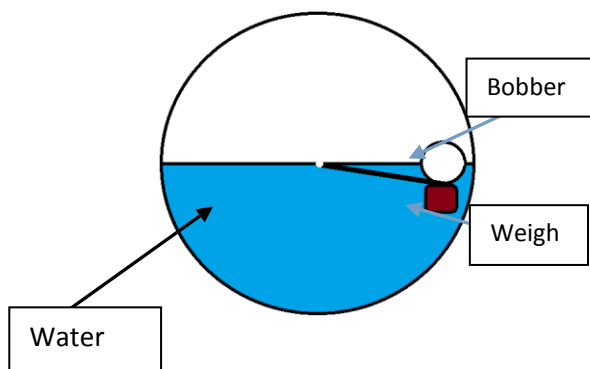
Θ = Angle subtended by height on centre of sphere

α = Initial Acceleration of bowl

h = Vertical distance moved by weight

ω = Final angular Velocity attained by bowl

1. At time t=0;



- Potential Energy is initially stored in extra mass in the right hemisphere of the sphere.
- Yet the conversion of potential energy is not spontaneous and thus work is required to be done.

At this stage if an angular impulse generating a torque “τ” is applied then,

$$\tau - \tau_d = I_1 \alpha$$

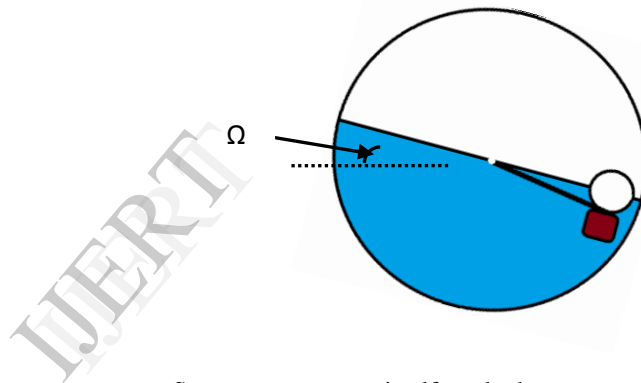
$$\tau_d = I_2 \alpha$$

Thus ,

$$\tau = (I_1 + I_2) \alpha$$

Besides τ<sub>d</sub> line frictional torque also acts but it is neglected due to very less effect.

2. At certain time t,



System rearranges itself such that mass on left and right hemisphere is same

Suppose the solid angle subtended by the displaced liquid on the left part with the

Thus M<sub>w</sub>=M

$$(\rho R^3 \Omega) / 3 = M$$

$$\Omega = (3M) / \rho R^3 \quad (1)$$

Consider the fractional part of sphere occupied by displaced liquid

Then surface area of shaded portion can be approximately taken as

$$(2\pi R) / 2 \times (h/2)$$

(since Ω is very small )

$$= (\pi R h) / 2$$

Thus Solid angle “Ω” is = Surface Area of Sphere / (Radius)<sup>2</sup>

$$= \pi R h / 2R^2$$

$$= \pi h / 2R \quad (2)$$

From 1 & 2 we get,

$$3M/\rho R^3 = \pi h / 2R$$

$$h = (3M \times 2R) / (\pi \rho R^3)$$

$$h = 6M / \pi \rho R^2$$

Where h is approx the vertical distance moved by the block

It is this potential energy that gets converted to kinetic energy of bowl when some work is done

i.e.

$$W_d - \text{Potential Energy} = \text{Kinetic Energy of Bowl}$$

Suppose we apply initial torque  $\tau$ ,

$$\tau = I\alpha$$

If work done by resistive drag force of liquid on bowl is neglected then,

$$W_d = I\alpha\theta$$

Where,  $I = I_1 + I_2$

Let Angular velocity attained by bowl at final stage be " $\omega$ "

Then,

$$I\alpha\theta - Mgh = (I_1\omega^2)/2$$

$$I\alpha h / R - Mgh = (I_1\omega^2)/2$$

$$\omega^2 = 2(I\alpha h / R - Mgh) / I_1$$

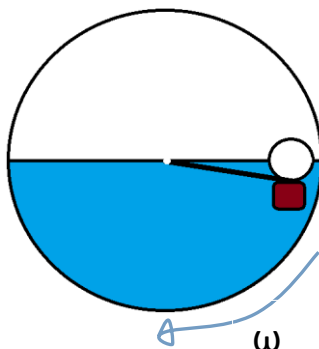
$$\omega^2 = 2[(I_1 + I_2)\alpha h / R - Mgh] / I_1$$

$$\text{Now, } "I_1" \text{ Moment of Inertia of Spherical shell} = \frac{2}{3}(M_1 R^2)$$

$$"I_2" \text{ Moment of Inertia of solid hemisphere} = \frac{2}{5}(M_2 R^2)$$

$$\omega^2 = 2\{[(\frac{2}{3}(M_1 R^2) + \frac{2}{5}(M_2 R^2))\alpha h / R - Mgh] / [\frac{2}{3}(M_1 R^2)]\}$$

$$\omega = \sqrt{2\{[1 + 3/5(M_2/M_1)]\alpha h / R - Mgh / [\frac{2}{3}(M_1 R^2)]\}^{1/2}}$$



## 5. EXPECTED OUTCOME AND FUTURE SCOPE

By preparing an apparatus on the topic "POWER GENERATION USING GRAVITY AND BOUYANCY FORCE" we will be able to produce electricity voltage in between the range of 1.2V-6V. When compared to other sources of energy like hydal, thermal, tidal, wind, nuclear etc Gravity is more abundant and available everywhere on the earth. Moreover it is eco-friendly. The output of the equipment depends on specifications of the generator, disk, electric circuit, battery. So, by increasing the specifications of the components we can improve the power output. The applications of this project are

- Appliances like flash lights, radios, lanterns, torches, calculators, watches and cameras with low voltage ranging between 1.2 -9V can be powered.
- Cell phone batteries oscillating between 3.6 – 4.2V can be charged.
- Toys with batteries' voltage ranging between 1.2 – 9V can be power.
- Alkaline and Zn-C batteries that require 1.5V are charged.
- Ni Cd and Ni MH with voltage 1.2V are charged.
- Li cells of 3V can be charged.

### 5.1 Future Scope:

Whether a developing nation with ambitions of economic growth, or an industrialized region moving towards a low carbon economy, the challenges of future electricity production are shared. Therefore an attempt is made to generate electricity with an eco friendly concept using Gravity.

The shown prototype is a simple one which generates little voltage. Researches are being carried out to make improvements to this idea. The major cost involved in this project is with the PMDC Generator. It can be made economical by minimising the generator cost. Large scale production can be achieved using this knowledge.

## 6. REFERENCE

- 1) Claude.anaar, Gravity- based vehicle power system, Patent No : US006809426B2
- 2) Justin Scott Roland , Method and system using liquid dielectric for electrostatic power generation, Patent No : US 7446,750 B2
- 3) TakuHirasawa ,JyunpeiMatsuzaki , Piezoelectric power generating mechanism with spring material, Patent No : US 8,022,600 B2, Application No : 12/374598, United states patent office.
- 4) Jerry W Robinso ,System for rotating a device mechanism for power generation , Patent No : US4691115 Application No : 824713 United States patent office Database.
- 5) Kuni Hashimoto, Power Generating Apparatus and Vaccum Generating apparatus by applying Vaccum Patent No: US5671602 Application No :421425, United States patent office Database.
- 6) <https://www.google.com/?tbm=pts>
- 7) <http://en.wikipedia.org>