

# A REVIEW ON GRAVITY BATTERIES

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## ABSTRACT

A low-cost gadget is created that can capture the energy of an object falling due to gravity. Through the placement of a high strength nylon thread at a specific height, an object is suspended from the apparatus. An item put at a specific height experiences gravitational potential energy, which is transformed into kinetic energy. The wheel, which is linked with a gear train, revolves as the object drops. The pinion positioned on the generator shaft is further rotated by this gear train. At the generator's armature terminals, an electrical output is generated that is adequate for a variety of uses. This system transforms mechanical energy generated by a person into gravitational potential energy, which is then transformed into electrical energy. This gadget can be utilized wherever on Earth regardless of location, weather conditions, time, and fuel because nearly all renewable energy sources have limited applications due to their operational requirements. The gadget has the ability to take the role of chemical batteries used in solar street lighting and can also be utilized as a mechanical battery. The constructed prototype is prepared for use in field applications.

**Keywords:** Energy Storage; mechanical battery; Gravity powered battery; Gravity battery; Energy Storage Device.

## 1. INTRODUCTION

Alternative energy sources are non-polluting methods that draw power from the environment's abundant renewable energy sources. Alternative energy sources include biomass, geothermal, hydropower, solar, wind, and tidal energy. Unlike conventional energy sources, alternative energy sources do not harm the environment. The use of biomass fuel is an exception because it results in some air pollution. The shortcomings of alternative energy sources continue to be a barrier to their success [1]. The expense of using nuclear energy is increased by the need for a high level of security during operation and proper nuclear waste disposal [2]. Solar energy is sporadic and ineffective in regions

with a preponderance of cloudy skies [1]. Hydro energy damages local animals and increases a region's vulnerability to earthquakes and terrorist attacks [3]. In places with relatively little wind speed, wind energy is ineffective due to its intermittent nature [4]. Tidal and geothermal energy are incredibly region-specific. There is a need for an energy source that can be used to generate electricity while taking into account characteristics like efficiency, independence from environmental conditions, independence from the location in which it can be used, accessibility, environmental friendliness, affordability, and ease of use.

There comes a time when even the most widely used sources, such solar, wind, tidal, and geothermal energy, are unable to provide all of these demands at once [5]. The weakest of all the basic forces is gravity. Gravity is a powerful force that dominates the interactions of matter at the galactic scale. It controls astronomical behavior by affecting the motion, structure, and forms of every celestial body.

For life to exist on Earth, there must be gravity. Depending on an object's mass, gravity determines its weight, creates ocean tides, and generates winds. The Earth has a much greater mass and density than any other object on its surface, with a mass and density of 5.97237 10<sup>24</sup> kg and 5.514 g/cm<sup>3</sup>, respectively. As a result, Earth's surface has a constant acceleration from gravity of 9.8 m/s<sup>2</sup>, whose value diminishes as one moves away from the surface. The acceleration caused by gravity is 9.789 m/s<sup>2</sup> at the equator and 9.832 m/s<sup>2</sup> at the poles. An object's gravitational potential energy increases in direct proportion to the height at which it is lifted. This potential energy becomes kinetic energy when it is dropped. On the entire surface of the earth, gravity is always present and easily accessible.

One potential solution to the rising energy needs and environmentally sustainable energy generation at the same time is the use of gravity energy [6]. Hydroelectric power plants generate electricity by converting the potential energy of stored water into kinetic energy, which is then used to turn the turbine. As mentioned above [3], hydro power plants have their own disadvantages. This paper discusses another efficient approach for capturing the energy of falling objects. The proposed system raises the thing off the ground using the mechanical energy produced by any human.

Gravitational potential energy is the form in which this mechanical energy is kept. When the object is allowed to fall naturally, the string, whose other end is wrapped around a wheel, is pulled down. The wheel that further turns the pinion through a certain gear arrangement is installed on the same shaft as the driving gear of that gear arrangement. The mechanical battery "Flywheel" that is currently in use is not at all comparable to this work [7]. The proposed mechanism is a methodology, whereas the flywheel stores energy as rotating energy. This energy, which the object at a certain height possesses, can be used to turn a gear system, which then turns the pinion attached to a dynamo or alternator for electric power. By choosing an appropriate weight and a suitable gear configuration, the rate at which an object descends may be controlled [9]. The energy generated can be used for domestic tasks like lighting the bulbs.

## 2. CATALYST

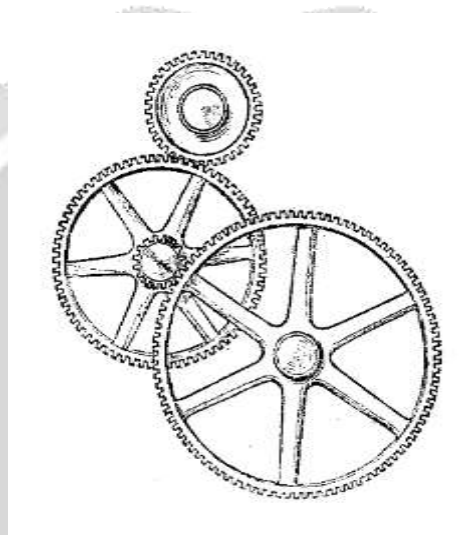
Normally, it takes about 0.5 seconds for an object to hit the ground after being raised to a height of 5 feet. Power produced in this brief period will be more akin to an impulse or spike that needs to be converted into a storage-compatible form using a number of electrical components [10]. The object will also need to be manually raised to a height of 5 feet due to the decreased time to hit bottom. It is not feasible to create an electricity generation system that necessitates constant human involvement. The time it takes to descend can be multiplied by several with the use of the right gear arrangement. When lowered through a gear arrangement, the same object took 25 seconds to reach the bottom. The requirement to raise the object every second has been improved to every minute, and with additional study, this requirement could be improved to several hours. The technique can be employed everywhere, regardless of the local weather, at any time because the primary energy source is gravitational potential energy. The suggested solution could give many rural homes access to enough electricity for household tasks. In the event of a natural disaster, this will also serve as a source of power in an emergency.

## 3. MACHANISM

A mechanical system called a gear train is created by putting gears on a frame such that they mesh together. Gear teeth are made to guarantee that engaging gears' pitch circles move on each other without slapping, allowing for a smooth transition from one gear to the next.

Gear and gear train characteristics include:

- The speed ratio and mechanical advantage of the gear set are determined by the gear ratio of the pitch circles of the mated gears.
- In a small package, a planetary gear train offers great gear reduction.
- It is feasible to create non-circular gears with teeth that yet smoothly transmit torque.
- Chain and belt driving speed ratios are calculated using the same formula as gear ratios. Check out bicycle gears.



An Agricola drawing from 1580 demonstrates a gear train that transfers power from a human-powered treadmill to a mining pump by engaging a toothed wheel with a slotted cylinder. The Antikythera mechanism of Greece and the south-pointing chariot of China are the earliest examples of rotation being transmitted between contacting toothed wheels. Gear trains with cylindrical teeth can be seen in the illustrations of the Renaissance scientist Georgius Agricola. A common gear design with a constant speed ratio was produced by the use of involute teeth. The pitch circles of meshing gears roll on each other without slipping because the number of teeth on a gear is proportional to the radius of its pitch circle. The ratio of the pitch circle radii and the ratio of the number of teeth on each gear can be used to calculate the speed ratio for a pair of meshing gears.

The mechanical benefit of two meshing gears with  $N_A$  teeth on the input gear and  $N_B$  teeth on the output gear is given by

$$MA = N_B / N_A$$

where  $N_A$  is the number of teeth on the input gear and  $N_B$  is the number of teeth on the output gear.

This demonstrates that the gear train amplifies the input torque if the output gear  $GB$  has more teeth than the input gear  $GA$ . Additionally, the gear train minimizes the input torque if the output gear has fewer teeth than the input gear. A gear train is referred to as a speed reducer if the output gear rotates more slowly than the input gear. The speed reducer in this instance amplifies the input torque since the output gear must have more teeth than the input gear.

#### 4. MODEL DESIGN

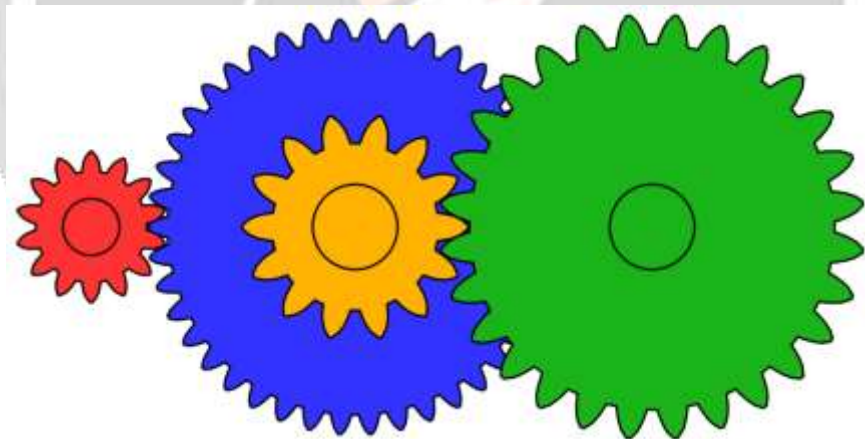
For ease of usage, the compound train in the prototype uses spur gears. Plastic spur gears were employed in the hardware design to keep overall costs low. The components that will be used should be strong and durable. The mount for the compound gear train is a base plate. The base plate is composed of Bakelite and is 17cm by 10cm by 0.3cm. These plates come in pairs. The PMDC generator is mounted using one sheet of metal. Each base plate has 6 holes bored into it, each measuring 5mm in diameter. Each hole is filled with 7 cm long bolts. Using spacers, the second plate is positioned on top of the first plate at a distance of 2 cm.

## 5. PROTOTYPE DESIGN

These spacers were made by measuring out used pens. All 6 bolts have spacers installed on them. They stop the second plate from tumbling into the first. Shafts with a 6mm diameter are placed into the holes. The shafts utilized here are 5 mm-diameter pieces of industry-grade Aluminium. A 10 cm long shaft is used to support the wheel and gear A. Gears A and B are mesh together. Between the two plates, spacers of 2 cm separate mesh gears. On a shaft that is 6 cm long, gear B is attached. After connecting gear B, the second plate is positioned above the spacers. Additionally, gear C is positioned on the same shaft as gear B. Gear D and Gear C are meshing.

Due to the fact that it is situated on the generator's shaft, gear D is also known as a pinion. The generator is installed inside a 1 mm thick metal plate. Four bolts hold the sheet metal plate in place. Three-centimeter spacers are installed on each of the four bolts. This offers enough room for the meshing of gears C and D.

180RPM center shaft DC The motor is a high-quality, reasonably priced DC geared motor that serves as a generator. Because the gearbox is sealed and a plastic ring covers the entire generator assembly, minimal maintenance is required. e. Although the motor only produces 150 RPM at 12V, it operates smoothly at voltages between 4V and 12V, producing a wide range of RPM and torque. To test the current generation and to highlight one of the prototype's uses, LEDs are utilized as the load [17],[18]. A sturdy nylon thread will be used to suspend the items.



## 6. HARDWARE RESULT

With the aid of nails, the prototype was fixed to a height of 1.52 m (5 ft). Through it, a 1 kilogram mass was suspended. In order to demonstrate that the operation of the prototype is independent of the type of object and purely depends upon object mass, 1 kg mass was a bottle filled with sugar and water. The amount of time it took the thing to reach the floor was noted. The bottle didn't strike the ground for 25 seconds. In the interim, a load was connected across the generator's output terminals. LEDs were used as the load, which may be used to quickly confirm whether there is electricity flowing through the circuit. This is because the heavier object will be subject to greater forces from gravity.

The force that applies torque to the wheel is the object's gravitational force. Gear failure due to fracture is possible if the applied torque exceeds a specific critical value. The bending forces on the shaft will be larger the heavier the load. The alignment of the gear train will be affected if the shaft is not straight and bends, which will significantly reduce the prototype's efficiency. By restricting the weight of the item that may be strung through the thread, this could be avoided. The maximum weight for this prototype is 2 kg; anything that weighs more than this would harm the device. demonstrates with great clarity how, with the use of an appropriate mechanism, it is possible to capture energy from an object falling due to gravity. The values for various initial conditions are displayed in tab

## 7. CONCLUSION

Due to energy losses involved at various stages of the process, ranging from gear loss to losses at the generator end, hardware results differ from the results of the circuit simulation. It is possible for people to harness energy with some mechanical work. There may be a highly affordable, user-friendly, and simple-to-design methodology. Comparing the methodology to chemical batteries, it is more environmentally beneficial and practically carbon neutral. The prototype can be utilized in rural regions to replace the pricey batteries used with solar panels as well as to light up homes during power outages. The methodology can be enhanced and scaled up to meet higher energy requirements with additional study.

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