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Power Generation using Speed Breaker with the help of a Rack and Pinion Mechanism

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Abstract

Energy is the most basic and essential need for all living things on the planet. Energy is the driving force behind any country's economic development. In today's world, conventional energy sources produce the majority of energy. However, the world's population is growing at an alarming rate, and conventional energy sources are becoming scarce. This paper harvests energy from a speed breaker by arranging gears and employing electronic devices. Saving a lot of money allows for the generation of a large amount of electricity. and, if implemented, will be extremely beneficial to the government. When a vehicle is in motion, it generates various forms of energy due to friction between the vehicle's wheel and the road, i.e., a rough surface. Heat energy is also produced when a fast-moving vehicle collides with the wind. Potential Energy to Electrical Energy Conversion is the principle at work. A power production system exists that converts the potential energy created by a vehicle moving up on a speed breaker into kinetic energy. The vehicle gains height as it moves over the inclined plates, increasing the potential energy wasted in a conventional rumble strip. When the breaker is tripped, they crank a lever attached to a ratchet-wheel mechanism, an angular motion converter, which rotates a geared shaft loaded with recoil springs. The shaft's output is connected to a dynamo, which converts kinetic energy into electricity.

Keywords

Rack, Pinion, Recoil Springs, Geared Shaft, Electronic Gadgets, Power Generation Using Speed Breaker and Dynamo.

1. Introduction

Many people in India are affected by a shortage of clean and reliable energy sources such as electricity. Around 1000 million people in India continue to rely on traditional biomass energy sources such as fuel, wood, agricultural waste, and livestock dung for cooking and other home requirements. agricultural waste, and livestock dung for cooking and other home requirements. Electricity is necessary at every point in our everyday lives, and population expansion has resulted in a reduction in conventional energy sources. Many more helpful power generation strategies have arisen as a result of the great growth of technology and familiarity with them. Figure 1 shows power generation in India by each sector. The newly developed techniques are concerned with cost-effectiveness. This research report outlines one such method of electricity generation.

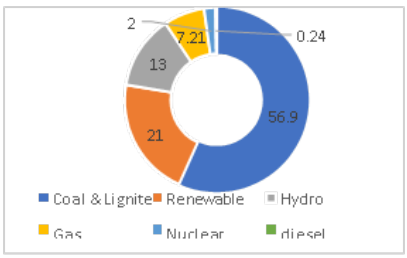

Figure 1. Power Generation Capacity of India

Many automobiles drive on highways today, and their motion generates kinetic energy. These vehicles spend a lot of energy on the road because of speed breakers. The increased traffic and quantity of speed breakers these days underline the need for the development of an inventive gadget that can harness the energy of vehicles that would otherwise be wasted on speed breakers to do some profitable activity. This kinetic energy can be captured at the speed breaker and used to create electricity. A fixed electro- mechanical unit is located beneath the speed breaker, as described in this project report. Roads are an important mode of transportation, and the number of wheels on the road grows in tandem with the population. Today, many autos travel on roadways, generating kinetic energy. Because of speed breakers, these vehicles expend a lot of energy on the road. Rising traffic and the increasing number of speed breakers these days highlight the necessity for the development of a creative device that can collect the energy of vehicles that would otherwise be squandered on speed breakers and use it to accomplish some profitable activity. This kinetic energy can be harnessed and used to generate power for the speed breaker. As explained in this project report, a fixed electro-mechanical unit is installed beneath the speed breaker. Roads are an essential mode of transportation. As the population grows, so does the number of wheels on the road. With the evolution of high-speed communications. A rack and pinion linear actuator are composed of a circular gear (the pinion) that engages a linear gear (the rack), thereby translating rotational motion into linear motion. Figure 2 shows the Pictorial Representation of the Rack and Pinion. The rack is driven in a linear direction when the pinion is rotated. The pinion will rotate if the rack is driven linearly. Both straight and helical gears can be employed in a rack and pinion drive. There is no scientific evidence to support the assumption that helical gears function more silently.

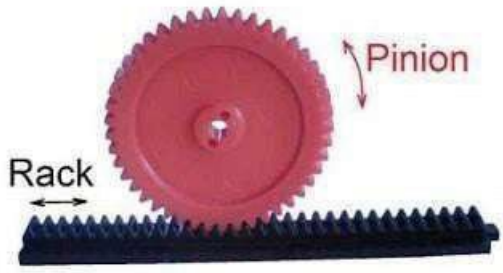

Figure 2. Rack and Pinion

2. Methodology

The Report is concerned with producing electricity from a setup similar to that used for speed breakers. Thus, the load applied to the speed breaker configuration is transmitted to the rack and pinion configurations. The rack and pinion arrangement are used here to convert the motion of the speed-receiving breaker into rotary motion. Figure 3 shows the schematic diagram of speed breaker system.

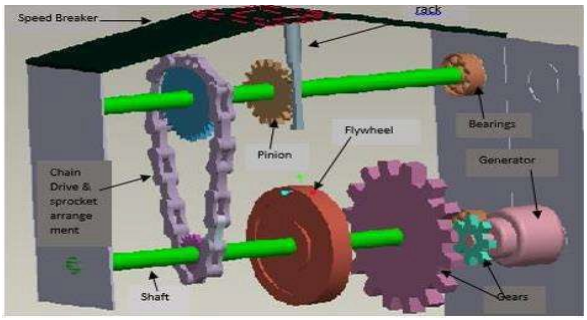

Figure 3. Schematic Diagram

The pinion's axis is linked to the sprocket arrangement. Two sprockets are used in the sprocket arrangement. One is in greater size, and the other is in a smaller size. A chain connects both sprockets and distributes power from the

larger to the smaller sprocket. As power is passed from the bigger sprocket to the smaller sprocket, the speed available at the larger sprocket is approximately multiplied at the smaller sprocket. The smaller sprocket's axis is linked to a gear arrangement. The whole system is represented in Figure 4.

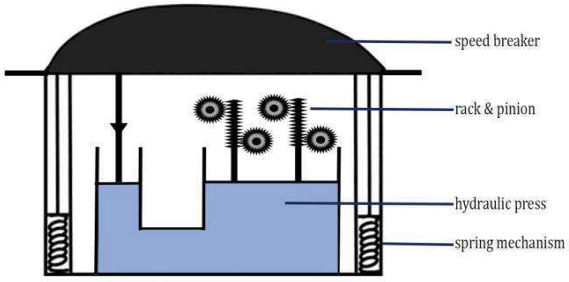

Figure 4. Speed Breaker Arrangement

We have two gears of varying sizes here. The larger gear wheel's axis is coupled to the smaller sprocket's axis. As a result, the multiplied speed located on the smaller sprocket wheel is transferred to the bigger gear wheel. The smaller gear is interconnected with the larger gear. The larger gear revolves at the multiplied speed of the smaller sprocket, while the smaller gear rotates at the multiplied speed of the larger gear in front of it increasing the speed even further. As a result, while the rotating motion's velocity the result obtained with the larger sprocket wheel is smaller., as power is transferred to the gears, the speed is eventually doubled to a greater speed. This speed is adequate to turn a generator's rotor, is fed into the generator. This emf is then supplied to an inverter and regulated. This controlled emf is now transferred to the storage battery and stored overnight. Fig. 6 shows the flow process of energy generated by the speed breaker arrangement. At night, this current is utilized to illuminate both sides of a long stretch of road.

2.1 Speed Breaker: It is the system's top portion, which is made of iron in a curved shape. The primary function of this speed breaker is to hold vehicle pressure and squeeze it as a vehicle passes past it.

2.2 Rack and Pinion Gear: This is one of the most basic types of equipment and can be customized to meet one's specific requirements. The rack is a linear gear, and the pinion is a circular gear. As the name implies, this type of gear has two components: the rack, which is a straight gear with teeth only in one direction, and the pinion, which is a round-shaped gear that will roll upon the rack to perform its task. This gear will be vertically aligned.

2.3 Spring Arrangement: When spring is loaded, it distorts and returns to its original shape when the load is removed. Its cushions absorb or manage the energy emitted by shocks or vibrations.

2.4 Chain Drive: It is a method of transferring mechanical power from one location to another.

2.5 Shaft: A shaft is a spinning machine element with a circular cross-section that is used to transfer power from one part to another or from a power- producing machine to a power- absorbing machine.

2.6 Fly Wheel: The flywheel's primary function is to act as an energy accumulator. It reduces speed fluctuations. When demand is low, it absorbs energy and releases it when it is needed.

2.7 Generator: A generator is a mechanical device that converts mechanical energy into electrical energy. A device that generates alternating current (AC) by mixing stationary (stator) and moving parts is known as an alternating current generator (AC generator) (rotor). The rotor is linked to the gear. The torque produced by the gear rotates the generator's rotor. The rotor generates a moving magnetic field around the stator, which induces a voltage difference between the stator's windings and produces the generator's alternating current (AC) output.

2.8 Battery: An electric battery is a device that stores energy in the form of one or more electrochemical cells (Figure 5).

Figure 5. Flow Process of Energy

3. Materials

Mild steel is low-carbon steel. Mild steel, also known as low carbon steel, contains between 0.05 and 0.25 percent carbon by weight. High carbon steel, on the other hand, can contain up to 2.5 percent carbon by weight. Mild steel is not alloy steel because it does not include significant concentrations of any elements other than iron and ferrite.

1.	Rack	Mild steel
2.	Pinion	Mild Iron
3.	Sprocket wheels	Mild steel
4.	Chain	Mild steel
5.	Spur gears	Cast Iron
6.	Springs	Mild steel
7.	Shaft	Mild steel
8.	Speed breaker	Mild steel

Higher carbon steels simply have more carbon, which results in distinct qualities such as high strength and hardness levels as compared to mild steel. This steel is particularly machinable due to its low carbon content. It can be cut, machined, and shaped into complex shapes without introducing proportionate stresses to the workpiece. It also aids in greater weldability.

Design and Modelling are presented in Figure 6 to Figure 12.

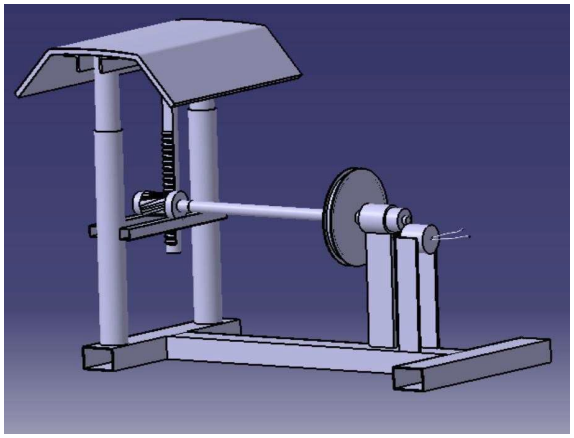

Figure 6. 3D Sketch of Assembly of Speed Breaker in CATIA Software

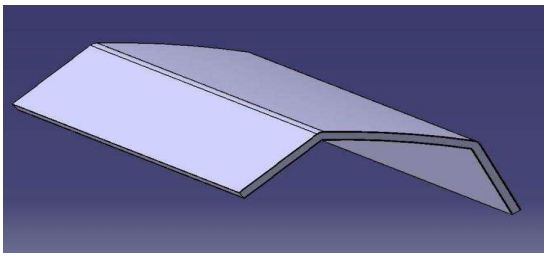

Figure 7. 3D sketch of the Speed Breaker plate

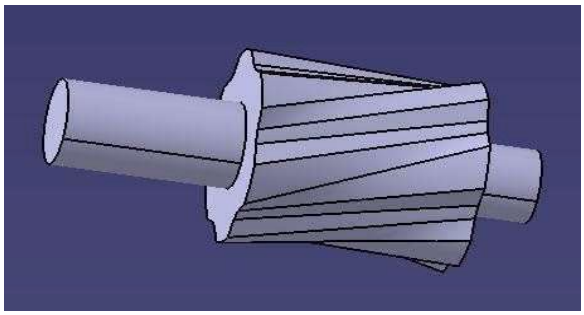

Figure 8. 3D sketch of Pinion in CATIA

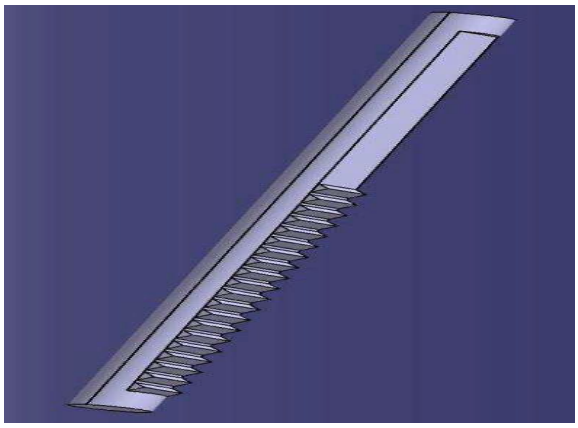

Figure 9. 3D sketch of Rack in CATIA

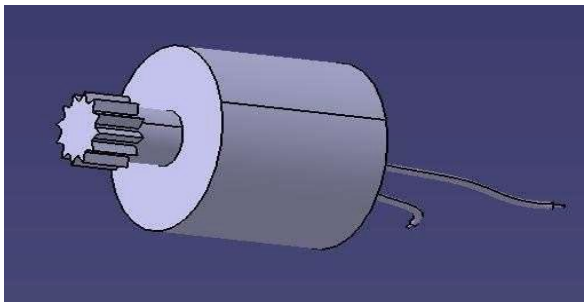

Figure 10. 3D sketch of Dynamo in CATIA

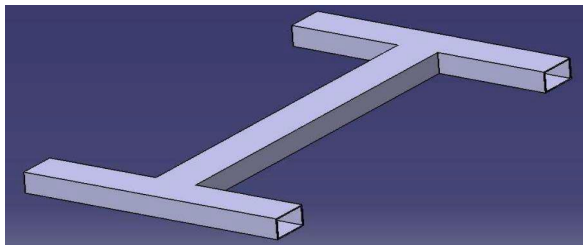

Figure 11. 3D sketch of Base in CATIA

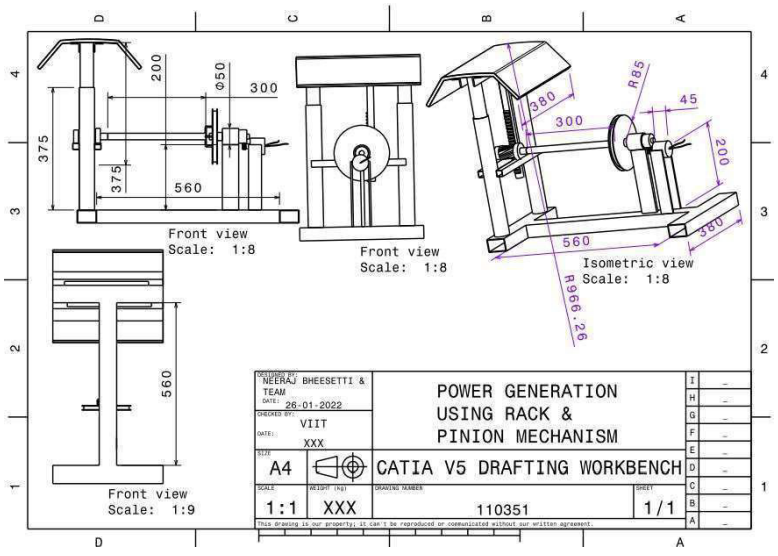

Figure 12. Drafting

5. Results and Discussion

- Any vehicle going over the speed breaker has a mass of 300Kg (Approximately)
- 15 cm is the height of the speed brake.
- Work done = body weight multiplied by vehicle distancetravelled
- Here, Body Weight = 300 Kg x 9.81
  = 2943 N
- The distance travelled by the body matches the height of the speed breaker, which is 15cm.
- Work done per second = (2943 x 0.15)/60 = 7.3575 Watts
- Power developed for a single- vehicle travelling at high speeds in aBreaker arrangement for one minute = 7.3575 watts
- The power produced in 60 minutes (1 hour) = 441.45 watts

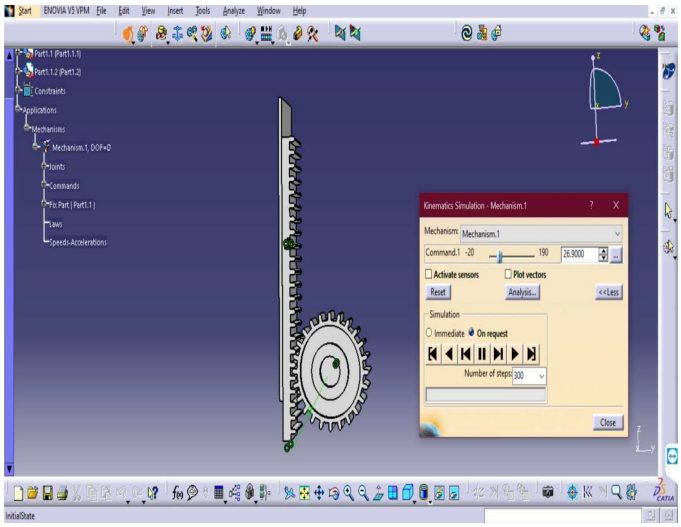

Figure 13. 3D Simulation of Rack and Pinion in CATIA Software

This mechanism of rotary motion is created by converting reciprocating motion into rotary motion (Figure 13). Rotational power (i.e., mechanical energy) is transformed into electrical energy by utilizing a gear arrangement and a generator that generates electricity. And the electricity generated can be put to use in a variety of ways. When we consider a speed breaker height of 10 cm and a 1500 kg car crossing the speed breaker, we can generate a significant amount of power. For one minute, this equates to 24.52 W of power. Thus, an hour generates approximately 1.47 kW of power, which adds up to 35.31 kW of power per day. This equates to a large value and is sufficient to power 4-6 street lights per day.

6. Future Scope

If implemented, it will greatly contribute to energy generation, lowering the burden on power plants and making more electrical equivalents available for industry, resulting in the nation's progressive development.

7. Conclusions

This sort of power generation has been identified as being less expensive than many other choices, and the model has less parts, thus assembly would be very cheap with all of the components readily available and no model-specific parts manufactured. This type of electricity generation aids in the conservation of conventional resources by generating electricity from readily available renewable natural resources.

This method can generate electricity without relying on other factors and can meet the high demands of the future. It is also a non- harmful process for the environment. There is also no impediment to traffic flow. There is no need for manpower resources in this case because it is automatic.

This has many applications, such as street lights and traffic lights, which prevent accidents from occurring "Electricity is a need in our daily existence." This power generation mechanism is yet another creative approach to creating green power to boost the country's development by better utilizing available resources. Because of the population explosion, current power generation is no longer adequate to meet our needs.

As the countries and the world's electricity demand rise in the coming days, it will be a great boon to the country and the world, as it will save a lot of electricity from powerplants that are currently being wasted in illuminating street lights.

This research can be used to help our country develop by improving and more effectively utilizing its resources. A country's development is directly proportional to how well and efficiently it uses its power supply. This is the time to put these creative ideas into action. This concept provides an alternative and contributes to the country's economy. Every country's development is the development of the world.

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