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Low Cost Automatic Power Generation Mechanism Using Speed Breakers

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Abstract. The goal of this project is to design and manufacture an energy source that generates electricity by replacing standard speed breakers with a more efficient mechanism called a speed breaker power generator. When a vehicle passes over the speed breakers, the speed breaker itself collapses owing to the vehicle's weight, resulting in the creation of energy through the mechanism we use under the speed breakers. Although this is a non-conventional energy source, the fabrication costs are lower. The various stages of research, design, and manufacturing that were involved in the construction and manufacturing of speed breaker power generation mechanisms and the efficient mechanism, rack and pinion mechanism, and construction of various components such as springs, rack and pinion arrangement, and generator were mentioned and explained in detail in this report. It also explains why certain components and building methods were chosen for the mechanism's efficient operation.

Keywords. Speed breaker power generator,Non-conventional energy source, rack and pinion mechanism.

1. INTRODUCTION

An energy crisis is a serious problem with an economy's electrical supply, and in recent years, population increase and industrial development have resulted in a global need for energy. There is a significant demand for low-cost, easily accessible resources. Over 40% of the population uses vehicles for daily activities, and we may transform the friction on the road (speed breakers, sudden breaks) into electricity through these activities. The term "speed breaker" refers to a group of traffic calming devices that use vertical deflection to reduce motor vehicle traffic and enhance safety conditions.

The speed hump, speed cushion, and speed chart are examples of variations. Vertical deflection devices are widely used around the world, and they are most typically used to enforce a low-speed limit of less than 40 km/h (25 mph). This research aims to demonstrate how energy may be harnessed and utilized in everyday systems such as road speed breakers. The number of vehicles travelling through the speed breaker on a daily basis is rapidly increasing. When a vehicle travels over a speed breaker, a significant amount of energy is wasted due to friction and heat loss.

There is a great possibility of tapping that energy and generating power by using the speed-breaker a power generation unit. We may leverage the kinetic energy of vehicles to generate electricity near the speed breakers, and the generated electricity can be used to power the lamps. Places like Toll bridges or parking stands are best and efficient for its utilization [1-2].

The process of generating electricity from primary energy sources is known as electricity generation. It is the stage prior to delivery (transmission, distribution, etc.) to end users or storage for utilities in the electric power industry. Electricity is not freely available in nature, so it must be produced (that is, transforming other forms of energy to electricity). Production is carried out in power stations (also called power plants). Electricity is most often generated at a power plant by electro-mechanical generators, primarily driven by heat engines fuel by combustion or nuclear fission but also by other means such as the kinetic energy of flowing water and wind. Solar photovoltaic and geothermal power are two alternative energy sources. The phase-out of coal-fired power plants and, eventually, gas-fired power plants, or the capture of their greenhouse gas emissions, is a viable option.a critical component of the energy revolution needed to combat climate change with the electrification of transportation, residences, and industry, much more solar and wind power is expected to be required [3]. There are several basic methods for converting various sources of energy into electrical energy. Rotating electric generators or photovoltaic systems are used to generate electricity at a utility scale. Batteries contribute a minor fraction of the electric power distributed by utilities. The electric effect, the piezoelectric effect, the thermoelectric effect, and beta voltaic are other types of power generation employed in niche applications.

2. LITERATURE SURVEY:

Designing a pollution-free energy producing system is critical. The most recent approach for producing electrical power with minimal input is the speed breaker power generator (SBPG). This paper describes an experimental research using SBPG[4] to generate power. A rack and pinion mechanism is employed to generate electricity in this system. When a car hits the speed breaker, the rack moves lower and uses pinions to convert linear to rotary motion. Similar to solar technology, the rotating motion is transferred to a DC generator, which provides DC power that is stored in batteries. The generated power can be used for domestic or commercial purposes in the vicinity of the speed breaker.SBPG generates 273.24W on a single push when 400kg is applied, according to this study. In an hour, passing 100 cars weighing 400 kg may produce 54.59 kWh. This system makes use of the rack's downward as well as upward motion [5-6].

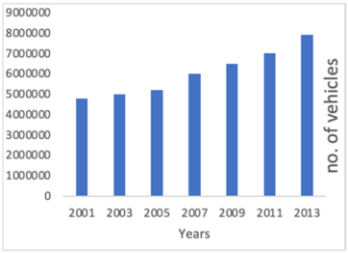

Figure 1: Traffic density in India

One might conclude that to be materially rich and prosperous, a human being needs to consume more and more energy. A recent survey on the energy consumption in India had published a pathetic report that 85,000 villages in India do not still have electricity [7]. Supply of power in most part of the country is poor. Hence more research and development and commercialization of technologies are needed in this field. India, unlike the top developed countries has very poor roads. Talking about a particular road itself includes a number of speed breakers as shown in figure1. By just placing a unit like the "Power Generation Unit from Speed Breakers", so much of energy can be tapped.

3. METHODOLOGY:

Methods Available:

Electricity generating road rib is a conceptual design that makes use of the wasted yet available energy procured from the unused energy that has not been converted from the vehicle fuel. A moving vehicle makes the rib move as well, which helps generate new renewable energy. We can provide the speed bumps on roads with specialized mechanisms under them. So, whenever a vehicle moves over the speed bump, the speed bump takes the kinetic energy of the vehicle and converts it into mechanical energy and which further converted into electrical energy. The methods to generate electricity through road ribs are as follows and their comparison is as shown in figure 2.

a) Roller mechanism
b) Spring coil mechanism
c) Pinion and Crankshaft mechanism
d) Compression method
e) Rack and pinion mechanism

Figure 2:Comparison Table

S.No.	Mechanism used	Merits	Demerits
1.	Roller mechanism	• Easier in construction • Less costly	• Less efficiency • Slippage
2.	Spring coil mechanism	• Consume less space • Better recoil	• Accelerated Corrosion due to low temperatures • Sudden impact can cause spring breakage
3.	Piston and crank shaft mechanism	• No direct connection with speed breaker	• Heavier in construction • Occupies more space
4.	Compression method	• Constant output	• Construction is difficult • High cost
5.	Rack and pinion mechanism	• Less backlash • Greater feedback • Accurate displacement	• More Guiding supports are required

3.1 Roller Mechanism:

The speed breakers in this kind of procedure directly produce the circular motions.Using various types of friction material as a speed bump covering material,

many writers conducted experiments on this procedure. However, with this approach, the vehicle's speed has a complete impact on the system's effectiveness. The system's efficiency is directly inversely correlated with the vehicle's speed. Therefore, the purpose of a speed bump in many business locations is to slow down moving traffic. In order to maximise the amount of energy that the speed bump can absorb from the vehicle, suitable friction materials are used in the construction of speed breakers. that the speed bump can take more energy from the vehicle. Every process uses a transmission system, which could be any type of gear train, chain sprocket, or belt drive, to transfer rotational energy from the speed breaker to the generator[8].

Working:

Since the speed breaker is a roller, both ends are supported by bearings.A friction substance is used to cover or wrap the speed breaker. Because of this friction between the wheels and the speed breaker and the bearing support, the roller speed breaker as shown in figure3 generates circular motions whenever a vehicle passes over it.This means that the circular motions are caused by the speed bump itself. Circular motions are transmitted via the transmission system to the generator. Since the speed breaker in this instance generates circular motion on its own, mechanical energy conversion is not required, hence there are fewer energy losses than in other processes. The transmission system, as usual, and the type of friction material used to wrap around the speed bump both affect the system's efficiency.

3.2 Spring coil mechanism:

Here, the simple energy conversion from mechanical to electrical, or the generation of electricity utilising the vehicle weight (potential energy) as an input while passing the speed breaker, is the basis for the operation of the spring coil mechanism. Here, we're creating a vibrating speed breaker that is pressed as a car drives over it before returning to its previous place. Due to the weight of the vehicle, a speed breaker moves downward when it is passed over as shown in figure4. Electricity is produced as a result of the dynamo's shaft rotating due to the speed breaker's downward action. Electric dynamo operation is as follows[9]. The whirling wire coil breaks the magnetic lines of force, causing current to flow through the wire. The mechanical energy of rotation is thus transformed into an electric current in the armature. The rotating motion between two shafts is transferred via a sprocket mechanism. The input gear of a gear mechanism is send to transmit power to the output gear.

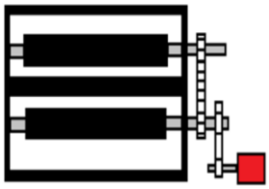

Figure 3: Roller Mechanism

Figure 4: Spring coil Mechanism

3.3 Pinion and crankshaft mechanism:

As is common knowledge, a crank shaft is used to change linear motion into a circular or rotational motion. The usage of this approach for power generation is good, but due to the system's numerous moving elements, heat and vibration will be produced in large quantities. So, when choosing these kinds of systems, the system should be the system's numerous moving elements, heat and vibration will be produced in large quantities. So, when choosing these kinds of systems, the system should be carefully constructed. The piston and crank shaft mechanism as shown in figure5 can produce circular motions because the specific speed breaker can support linear motion. These circular motions can be conveyed to the generator utilizing an effective transmission system as our primary goal is to produce electrical energy.

Working:

In this situation, the piston is employed to transform kinetic energy into linear motion.Due to the kinetic energy that has been transferred to the speed breaker, when the vehicle passes through it, it pushes down the piston.The crankshaft completes a half rotation thanks to the piston[10].The crank at the end of the connecting rods turns linear action to circular motion since it is built on the principle of inertia, pushing the piston up and returning it back to its original position while also bringing the speed breaker to its original position.In doing so, this mechanism produces a circular motion, which is accelerated by a gear mechanism.

3.4 Compression method:

The concept of mechanical vibrations served as the foundation for the design of the Speed breaker power production mechanism. Due to the weight of the car on the speed bump, it transforms potential energy into electrical energy. Between the speed bump and a DC alternator is where the air compressor is located. This mechanism's schematic diagram is displayed in figure 6.

Working:

When the vehicle passes over the speed breaker the piston of the pump goes down and airis compressed. This compressed air contains some velocity that can be used in the rotation of a turbine. A tank is provided for more compression and storage of air, it is not necessary if the force caused by the pump is very high. And then the exhaust air goes to the turbine which is connected to the generator resulting in generation of electricity.

4. PROPOSED METHOD:

Rack and Pinion Mechanism:

The speed breaker power generation mechanisms have been improved with the rack and pinion system. Numerous writers have investigated this mechanism experimentally. The linear motion is produced by a rack, and the rotating motion is produced by a pinion.

Working:

Every time a vehicle passes over the speed breaker, the speed breaker slides downward, compressing the spring to move the rack linearly downward. The transfer of linear motion to rotary motion occurs when the rack and pinion are in mesh. To enhance the number of revolutions, this rack and pinion arrangement is linked with two idler gears, one of which is coupled to the shaft of the dc motor. Through the transmission system and gear train, the rotating motion is conveyed to the generator and transformed into electrical energy. For later usage, such as to turn on the street lights close to the speed breaker, this generated electricity is stored in the battery.

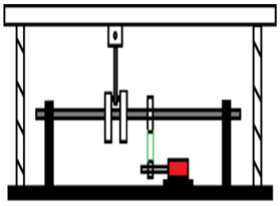

Figure 5: Pinion and crank shaft Mechanism

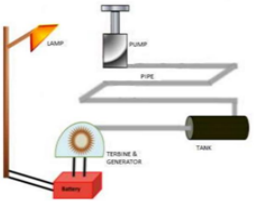

Figure 6: Compression method

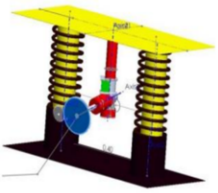

Figure 7: Rack and Pinion Mechanism Partial assembly

5. DESIGN METHODOLOGY:

Design approach:

Utilizing waste resources in the construction of the improved speed breaker is the primary goal of the design phase. During our brainstorming session, we came to the conclusion that using salvaged auto components would be preferable to doing nothing at all. Due to some terrible incidents, hundreds of cars are discarded into junkyards every day. The following components are put together using a bottom-up method. The lowest portion of the base plate is underground and is where it is located. The base plate's guidance pipes are then fitted with springs. The speed breaker will return to its former position thanks to the upward push provided by these springs. Following that, guide pipes are used to fit the top plate onto the springs. The actual speed breaker is served by this.

Then the rack and pinion is fitted at the centre of the top plate so that it can absorb maximum force of the vehicle. The rack and pinion are coupled with two idler gears which are their respective dynamos [11]. The rack and pinion is then installed in the middle of the top plate to absorb the greatest amount of vehicle force. Two idler gears, each of which is a dynamo, are coupled with the rack and pinion. Additionally, we needed to reduce the design so that we could make it using the tools at our disposal. For our design, we chose to take a bottom-up approach. For instance, we created supporting pipe structures on the base plate using welding techniques. Once the pipes were supported, we could insert the two springs that will be utilised to reposition the speed breaker. creating the rack and pinion system and the bearing housing for the gear shaft support. This allowed us to make any design alterations that were required throughout the manufacturing phase.

6. PROTOTYPE DEVELOPMENT:

Top plate assembly:

A rack, a few supporting pipes, and the top plate are all combined. Because the top plate as shown in figure8 is squeezed downward whenever weight or force is applied to it, the supporting pipes make sure that there isn't too much strain on them.

Base plate assembly:

The base plate as shown in figure9 is mainly made up of welding technique[12]. The two supporting pipes are welded to this base plate. The housing which supports pinion arrangement also welded to this base plate.

Figure8: Top plate with Rack

Figure9: Base plate with pinion housing

Rack and pinion arrangement:

Rack & Pinion as shown in figure10 is used to transfer vertical motion due to vehicle into rotarymotion of the dynamo.

Bearing housing:

The housing contains two bearings that support the shafts of the bigger and smaller gears as shown in figure11.Rotating components such as shafts or axles are held in place by rotary bearings, which also transmit axial and radial loads from the source of the load to the structure carrying it[13].

Gear assembly:

The rack is connected to the smaller gear's 16-tooth shaft, while the larger gear's 70-tooth shaft is connected to the rack. The bigger gear, which is coupled to the dynamo shaft as shown in figure 12, has a 12-tooth gear attached to its left and right sides

Figure10: Rack and pinion arrangement

Figure11: Rack and pinion arrangement

Figure 12: Large gear coupled with left dynamo

Dynamo assembly:

The wooden parts at the right and left sides of the main gear support the two 12 volt dynamos. The positive and negative terminals are connected to a 12volt rechargeable battery, which stores the energy produced and then supplies it to an LED light strap as shown in figure 13.

Production assembly:

All the different parts shown above were assembled to make a complete speed breaker as shown in figure14 which generate power as a vehicle passes over it.

Figure 13: Dynamo assembly

Figure 14: Production Assembly

7. CONCLUSION:

Because of the rising daily need for electricity, there will be a huge growth in the use of speed breaker power generators in the coming days. The goal of this research is to present yet another ground-breaking technique for producing green energy in order to enhance the world by utilising its resources in more beneficial ways and to contribute to its development. Any nation, particularly Nigeria and other developing countries, cannot advance without a reliable and consistent supply of electricity for its people, as opposed to intermittent power outages or unstable energy sources.

The moment has arrived to put these kinds of innovative ideas to use, thus they should be put into action. It is advised that additional advances be made to lessen the aforementioned difficulties. To reduce the inherent complexity and problems, this research can also be adjusted by using a camshaft and pulley stem or fluid mechanics concepts in place of gears. New concepts that would aid in lowering friction and boosting the effectiveness of the generators should be proposed using the concept of power generation.

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