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STUDY ON POWER GENERATION FROM SPEED BREAKERS

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Abstract: This study introduces a straightforward method of generating electricity by replacing conventional speed breakers with a simple mechanism. The proposed approach utilizes a rack and pinion mechanism, along with high-tension springs, to convert the motion of passing vehicles into electrical energy. This method presents an effective solution for electricity generation, especially in areas experiencing a surge in vehicle numbers. The system can be strategically placed near toll plazas, parking lots, and other high-density vehicle locations. The implementation involves a rack and pinion spring assembly mechanism that transfers the motion from passing vehicles to a DC motor/generator for electricity generation. This cost-effective approach harnesses the mechanical energy produced by dynamic vehicles on roads and efficiently converts it into usable electricity. The system's potential applications include addressing the increasing demand for electricity while capitalizing on the rising number of vehicles on the highways/roads. By tapping into the kinetic energy of moving vehicles, this method offers an environmentally friendly alternative to conventional power generation, reducing the dependence on fossil fuels.

Index Terms **- Electricity, Generation, Rack and Pinion, Mechanism, Harvesting.**

I. INTRODUCTION

The increasing demand for energy and regard about environmental sustainability has led to a growing interest in alternative energy sources. Conventional power generation procedures often rely on fossil fuels, contributing to pollution and climate variation. As a result, researchers are exploring innovative elucidation that can enrich to the energy mix while minimizing adverse environmental impacts. One such solution is harnessing energy from speed breakers, which are omnipresent in built up cities and suburban areas.

This study aims to delve into the intricacies of power generation availing speed breakers and highlight the multifaceted that make this technology a promising avenue for clean energy production. The paper will discuss the underlying principles, working mechanisms, technical challenges, environmental benefits, and potential applications of this technology. Additionally, it will examine real-world case studies and ongoing research efforts in this field, emphasizing the feasibility and scalability of implementing speed breaker power generation systems (Sharma .,2003).

II. PROCEDURE

Power can be prompted using both traditional and unconventional energy sources. In this study, we demonstrate energy reformation from kinetic energy to rotational energy and rotational energy to electrical energy independently. This design demonstrates how speed combers generate power. The process of generating energy from speed swell arrangements is simple but effective.

These automobiles are speeding past many speed combers on the roadway. We wish to substitute these typical speed combers with our contemplated speed swell. It's an electromechanical unit. For power generation and storage, this system employs mechanical and electrical technology. The generation will be commensurable to the business viscosity (Watts and G.;2004).

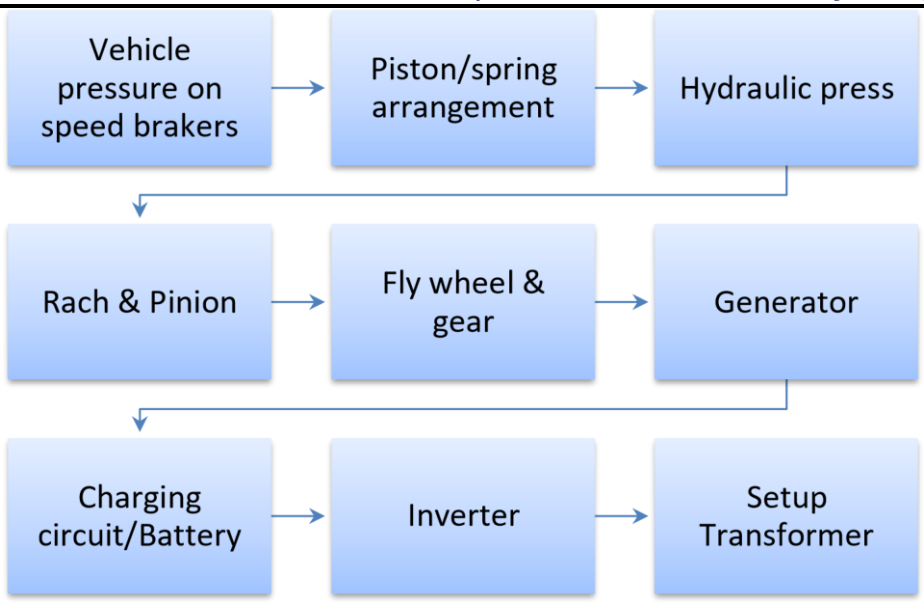

Fig.1-Block Diagram of RPG (Road Power Generation) System

III. Structure Construction & Function

The vehicles waste implicit energy that they retain while moving because of their weight. This kinetic energy can generate power by utilizing a special setting/arrangement called a "power hump." It's an electro-mechanical unit. It utilizes mechanical and electrical technologies for power generation and its storehouse. Whenever the vehicle is allowed to transit the pate, it gets compacted down. Also, the springs hooked to the pate are compressed, and the rack attached to the bottom of the pate moves over in repaying stir. Since the rack has teeth coupled to gears, there exists a conversion of repaying stir of the rack into rotator stir of gears, but the two gears circumvolve in contrary directions so that shafts will circumvolve with a certain rpm. The shafts are coupled through a set of gears to the pistols, which convert the mechanical energy into electrical energy. The conversion will be commensurable to business viscosity (Brandt and Granlund.,2008). The battery is charged by charging circuit. The inverter circuit changes the DC voltage to alternating voltage current, which is then increased by a step-up motor. A black seeing circuit is accustomed to scent the night and turn on the street light. A hydraulic press, according to this theory, turns pressure of vehicle on the speed swell into rotary energy via rack and pinion.

As a result, this rotary motion rotates the creator, generating electrical power that is reserved in a battery via a charging circuit (Rao et al., 2014). Figure 2 depicts the entire system.

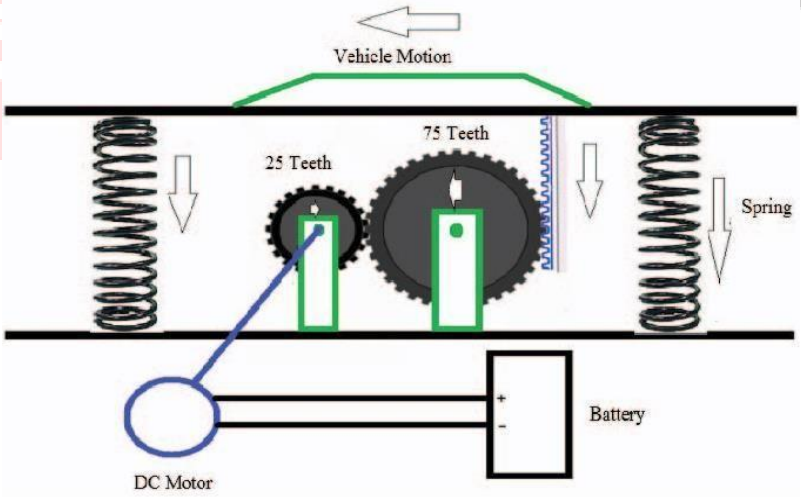

Fig.2- Rack & Pinion Mechanism

The speed swell system is conveyed to rack and pinion arrangements when the vehicle cargo is acted upon. The top section of the speed swell slides downward due to the weight of the vehicle (Pathan et al.,2019). The pressure rod, one end of which is hooked to the bottom of the speed swell and the other to a hydraulic press's little piston.

The hydraulic press multiplies the force from the little piston to the huge piston four times. The huge piston is equipped with three rakes. Each rack is linked by two one-way pinions. The back-and-forth motion of the rack is causing gyrating in the pinions. Every pinion is bended together to a cover wheel, which absorbs energy while demand is low and releases it when needed. The flywheel is linked to a huge gear, which is linked to a small gear, which is linked to a creator. Rotational energy is converted into electrical energy by the maker (Kaur et al.,2013) .When the vehicle delivers the speed swell, the springs expand and return the speed swell to its original position, causing the system to rear. A battery is charged by the charging circuit. The inverter circuit converts the DC voltage to alternating current voltage, which is then increased by a step-up motor. A dark sensor circuit detects the presence of darkness and activates the road lights

IV. SYSTEM DESIGN

This mechanism employs rack and pinion, hydraulic presses, speed breakers, spring arrangements, gear combinations, a generator, a battery, a sensor, a switching circuit, an inverter circuit, and step - up transformers.

A. Speed Breaker: The upper half of the system is formed of curved iron. This speed breaker's main duty is to maintain and compress vehicle pressure as a vehicle goes through it.

B. Spring arrangements: A spring is an elastic body that distorts when loaded and returns to its original shape when the weight is removed. It cocoons, absorbs, or manages energy due to shocks or climatic change (Mitsubishi.,2014). Four helical springs beneath the speed swell are compressed when the vehicle applies pressure, restoring the speed swell to its original state.

C. Hydraulic press: A hydraulic press converts a tiny force given to one liquid column into a considerably smaller force that is available to another liquid column. It is a Pascal's law operation. In our proposed system, when the pressure formed on the speed swells utilizing this equation, it turns the force into 4 times from a small piston to a large piston in our proposed system.

$$F1=(A1*F2)/A2$$

*F*1= converted to force by hydraulic press.
F2= created force on a small piston by a speed breaker.
A2 = area of small piston.
A1 = area of large piston.

D. Rack & Pinion: Rack and pinion devices can change the direction of motion from linear to rotary or vice versa (Anderson and Fouad.,2003).A circular gear is a pinion, and a linear gear is a rack. The rack's applied force is translated into rotation by the pinion. The rotational force is created by converting the mechanical force.

E. Flywheel: The role of a flywheel is primarily that of an energy storage device. It lessens speed peaks and valleys (Padiyar.,1996). It absorbs energy when the demand is low and releases it when it is high.

F. Generator: Generators are machines that transform mechanical energy into electrical energy. Alternating current is created by an AC generator, which is made up of a combination of stationary (the stator) and moving (the rotor) components. The gear is attached to the rotor. The generator's rotor is turned by the torque produced by the gear. The generator's alternating current (AC) output is produced by the stator's windings, which are surrounded by a moving magnetic field created by the rotor (Rao et al.,2014).

G. Charging circuit: The battery is charged with the help of a charging circuit.

H. Inverter circuit & step-up transformer: Inverter converts DC voltage to AC voltage, and a step-up motor is a type of motor that steps up the AC voltage.

I. Dark sensing and switching circuit: When darkness happens, the sensor senses it and switches on the light.

V. CALCULATION

Let,
Normal car mass = 1500kg (Avg.)
Car weight = acceleration due to gravity*Mass
= 1500kg * 9.81 m/s^2=14715N
Speed breaker height = 15cm=0.15m
Work done = Displacement * Force
= 14715*0.15=2207.25Nm
Power = Work done/ time
= 2207.25 /60 = 36.7875W
Power generated in the whole day = 36.7875*24hr*60min
= 56.45KW
If we are using a bulb which is 100W, and in two km 120 numbers bulb needed. The total watt consumed =120*100 =12000W
= 12KW

Since the above calculation shows us, the generated power from moving vehicles is sufficient to power road lights all night.

VI. ADVANTAGES

- No pollution during power generation.
- Maintenance cost is low.
- Construction is simple.

- Installation cost is low.
- No consumption of any fossil fuel.
- During power generation no need for manpower.

VII. DISADVANTAGES

- Expensive Infrastructure cost.
- Output energy is limited.
- Maintenance challenges.
- Interference with traffic flow.

VIII. ESTIMATING & COSTING

After careful analysis and detailed assessment, we have estimated the total cost of our innovative power generation from speed breakers to be ₹4540. This comprehensive costing includes all essential components, such as high-efficiency high speed motor, a reliable battery for energy storage, a durable rack and pinion for seamless operation, reliable springs, durable LED lights, steel pipes for robust structure, for fixed the setup we need plywood, nuts, and electrical wire for electrical connections. This investment ensures that our product is both affordable and of high quality, providing an eco-friendly, efficient, and autonomous solution for power generation.

Sl. No	Items	Quantity	Price/Piece (Rs)	Total cost (Rs)
1	Rack	1	1000	1000
2	Pinion	1	1000	1000
3	Spring	4	150	600
4	Steel pipe	1	350	350
5	Steel pipe	1	300	300
6	Clamps	3	50	150
7	Nuts	2	50	100
8	Motor	1	250	250
9	Stepup	1	550	550
10	Plywood	3 feet	66/feet	200
11	Electric wire	-	30	30
12	LED	2	5	10

Grand Total=4,540/-

IX. FUTURE SCOPE

The prospective expansion of this initiative involves enhancing the eco-friendliness of speed bumps by utilizing diverse materials in their construction. Furthermore, enhancing the power generation infrastructure could encompass incorporating alternative forms of power generators.

X. CONCLUSION

The described system presents a non-conventional and environmentally friendly approach to power generation (Nota et al.,2005).A key advantage of this system is its independence from external energy sources.

By implementing this innovative solution, we can significantly mitigate power crises and alleviate issues with load shedding. The surplus electricity generated can adequately cater to the daily energy demands of street lighting. Furthermore, the system can be harnessed for a variety of applications such as road signals, tollbooth operations, and other valuable tasks. It is evident that this system offers a highly effective means of addressing and reducing power shortages in Bangladesh from multiple perspectives.

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