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Power Generation Using Speed Breaker

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Abstract: *The rapid increase in energy demand and depletion of conventional energy resources have created a necessity for alternative and sustainable energy solutions. A significant amount of energy is wasted in transportation systems, particularly in the form of mechanical energy produced by moving vehicles. This research focuses on harnessing the energy generated when vehicles pass over speed breakers. The proposed system converts mechanical energy into electrical energy using components such as rollers, shafts, gears, and a generator based on electromagnetic induction. The generated energy can be stored and used for applications such as street lighting and traffic signals. This method is eco-friendly, cost-effective, and suitable for high-traffic areas. The system contributes to energy conservation and sustainable development.*

Keywords: Energy Harvesting, Speed Breaker, Mechanical Energy Conversion, Renewable Energy, Electromagnetic Induction

I. INTRODUCTION

Energy plays a vital role in economic and technological development. With increasing population and industrialization, the demand for electrical energy continues to rise. Conventional energy sources such as coal and petroleum are depleting rapidly and contribute to environmental pollution. To address these challenges, it is essential to explore renewable and sustainable energy sources. One such approach is utilizing wasted mechanical energy from vehicles. Speed breakers, commonly used for traffic control, generate mechanical energy when vehicles pass over them. This energy is typically wasted. The concept of power generation using speed breakers involves converting this wasted mechanical energy into electrical energy. The system uses mechanisms such as rack and pinion, gears, and shafts to convert linear motion into rotational motion, which drives a generator. This approach is environmentally friendly and suitable for urban and high-traffic areas.

II. LITERATURE

Several researchers have explored methods to generate electricity from speed breakers. Common mechanisms include:

- Rack and Pinion System: Converts vertical motion into rotational motion to drive a generator.
- Roller Mechanism: Uses rotating rollers under pressure from vehicles.
- Gear and Flywheel Systems: Improve efficiency and maintain continuous motion.
- Piezoelectric Sensors: The conversion of mechanical stress into electrical energy using piezoelectric sensors results in relatively small power generation.

Studies indicate that energy generation efficiency depends on traffic density. High-traffic areas such as highways and toll plazas are most suitable. However, challenges include mechanical wear, maintenance issues, and efficiency limitations.

III. METHODOLOGY

The system is developed through the following steps:

1. Design Phase: Selection of components such as speed breaker, gears, shaft, generator, and battery.
2. Fabrication: Construction of a movable speed breaker using durable materials.
3. Mechanical Setup: Installation of shaft and gear mechanisms for motion transfer.

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4. Generator Integration: Coupling the shaft with a generator.
5. Electrical Circuit Design: Energy storage using batteries and rectifiers.
6. Testing: Performance evaluation under different vehicle loads.
7. Optimization: Improving efficiency and reliability.

3.1 Proposed System Components

3.1.1 Speed Breaker

- Converts vehicle load into mechanical motion
- Acts as primary energy source

3.1.2 Gear Mechanism

- Transfers and amplifies rotational motion
- Improves system efficiency

3.1.3 Rack and Pinion

- Converts linear motion into rotational motion

3.1.4 DC Generator

- Converts mechanical energy into electrical energy

3.1.5 LED

- Indicates power generation

3.1.6 Springs

- Restore speed breaker to original position

3.1.7 Wooden Plate

- Provides base support

3.1.8 Frame Structure

- Ensures stability and proper alignment

IV. WORKING PRINCIPLE

The operation of the system is governed by the principle of electromagnetic induction. When a vehicle passes over the speed breaker:

1. The speed breaker moves downward due to applied force.
2. Linear motion is converted into rotational motion using mechanical mechanisms.
3. Rotational motion is amplified using gears.
4. The generator converts this motion into electrical energy.
5. Energy is stored in batteries and used for electrical applications.

The energy output depends on vehicle weight, speed, traffic density, and system efficiency.

V. ENERGY CALCULATION

$E = F * d$

Where:

$F = m * g$

$g = 9.8, m/s^2$

Example:

- Mass of vehicle = 300 kg
- Displacement = 0.1 m

$F = 300 \times 9.8 = 2940 \, N$

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VI. CONCLUSION

This system represents a creative method of producing electricity from mechanical energy that would otherwise be lost. It is eco-friendly, cost-effective, and suitable for implementation in high-traffic areas. Although the generated power is relatively small, it can effectively support low-power applications such as street lighting.
This project promotes renewable energy usage and contributes to sustainable development and energy conservation.

VII. ACKNOWLEDGMENT

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