

Energy Generation from Speed Breaker

Amrit Ghimire ^a, Manish Pandey ^b

^{a, b} Department of Electrical Engineering, Pashchimanchal Campus, IOE, Tribhuvan University, Nepal

✉ ^a amritghi55@gmail.com, ^b manishdhading67@gmail.com

Abstract

Energy has become the most essential requirement in human beings' life. So, alternative renewable resources should be properly utilized to harness energy. Energy can also be generated from speed breakers by using spring, crankshaft, chain sprocket, and generator arrangement on vertically movable speed breakers. The reciprocating motion of speed breaker when a vehicle passes over it processes to rotate crankshaft connected with chain sprocket and finally shaft coupled with generator shaft to produce energy. The energy is conserved in the battery. This process involves two-way energy production during speed breaker motion downward and upward direction.

Keywords

Crankshaft, chain sprocket, reciprocating

1. Introduction

Physical World comprises energy and masses. Everything holds energy within itself in various forms. It would be great if we could harness energy from those areas where energy will be regenerated, i.e., renewable energy resources. Other than that, there are a lot of energy resources, where they are going waste. In a world with the increasing energy crisis, utilizing waste energy is obviously a good idea. So, we found an area where energy is going as a waste and can also be collected with an appropriate concept, the speed breaker placed in roads usually in urban areas. Every time vehicle passes a bump structure, a speed breaker, tires exert a vertical downward force and its reaction force is absorbed by shocks. In the process, a large amount of energy usually gets wasted [1]. So, we designed a reciprocating motion for a movable speed breaker when the vehicle tire gets above it. When the position of the speed breaker is changed, the crankshaft attached to it gets rotated which eventually rotates the shaft attached to the crankshaft. The linear motion is converted into a rotating motion. Then chain sprocket arrangement is set in order to increase the speed of the shaft. The final shaft is connected to a generator and finally connected to the battery. The energy is intermittently generated because of irregularly arriving vehicles, so it may degrade battery life so, voltage regulator and charging circuit are connected. The flowchart is

shown in fig. 1. The generated energy can be utilized to operate street lights and other similar purposes.

2. System Design

The system generates energy from the speed breaker using a spring to create a reciprocating motion, and stability of the system after the vehicle puts pressure on the speed breaker. A crankshaft is put to convert linear reciprocating motion of speed breaker into rotational motion of shaft. Further, the shaft is connected with a chain sprocket which multiplies the speed to obtain higher power output. And the shaft is coupled with a generator that rotates to generate electricity. A full bridge rectifier is connected to the output terminal of generator. Rectifier converts generated AC power into constant dc power.

2.1 Speed Breaker

Speed Breaker is a hump concrete structure set up on roads in urban areas in order to reduce vehicle speed to avoid collision and accidents. Huge energy is wasted in such speed breakers while vehicle kinetic energy is converted into pressure energy. And we replace conventional concrete speed breaker with spring mounted steel plated speed breaker.

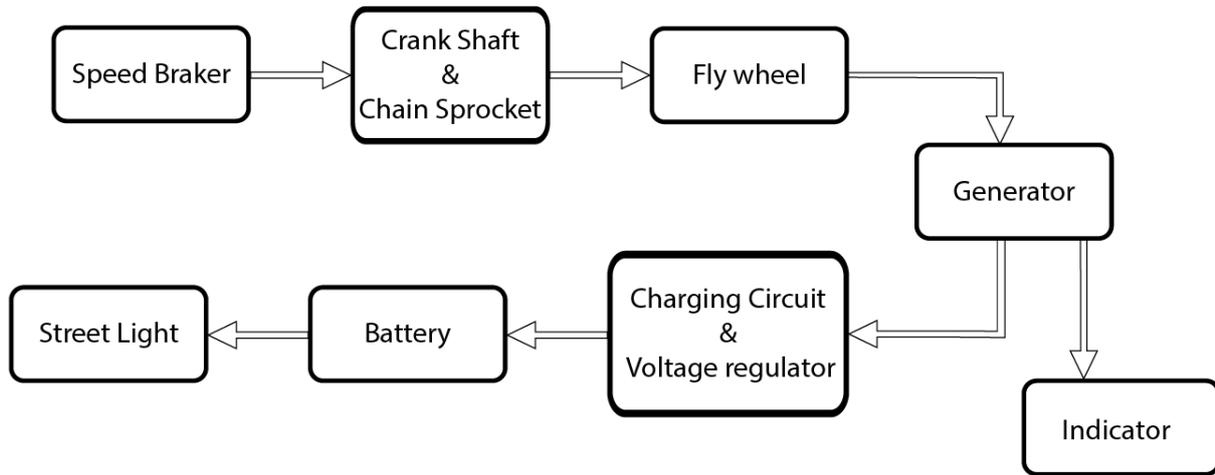


Figure 1: Flowchart of the system

2.2 Spring

A helical structure made up of hardened steel makes a structure that helps to retain the original position of the speed breaker after a vehicle passes over it. The reciprocating motion is brought to the system by spring. Spring parameters calculation,

$$D = \frac{W * n * N * R^3}{G * d^4} \tag{1}$$

- D = deflection in spring
- W = designed load
- R = mean diameter of coil
- d = diameter of wire
- N = No. of springs
- n = no. of spring turns
- G = Modulus of rigidity
- Unstressed spring length= 23 cm
- Diameter = 6 cm

2.3 Crankshaft

A crankshaft is a mechanical component that converts reciprocating linear motion into a rotational motion. Here, crank connects speed breaker with connecting rod and shaft.

- Crank diameter = 17 cm
- Connecting Rod length = 22 cm

2.4 Chain Sprocket

A chain sprocket is a combination of chain with sprocket that varies the speed of rotation of main shaft

and generator shaft. This arrangement multiplies the speed of main shaft with gear ratio to obtain higher speed of generator shaft. The gear ratio is 4.1.

2.5 Generator

Generators are electromechanical device that converts mechanical input into electrical output, working on the principle of Faraday’s law of electromagnetic induction. An AC generator of rating 0.065 watt is used.

2.6 Rectifier

Rectifier is an electronic circuit that converts pulsating AC waveform into constant DC signal. Full bridge rectifier with capacitor filter is used in the project.

$$C = \frac{I T}{U}$$

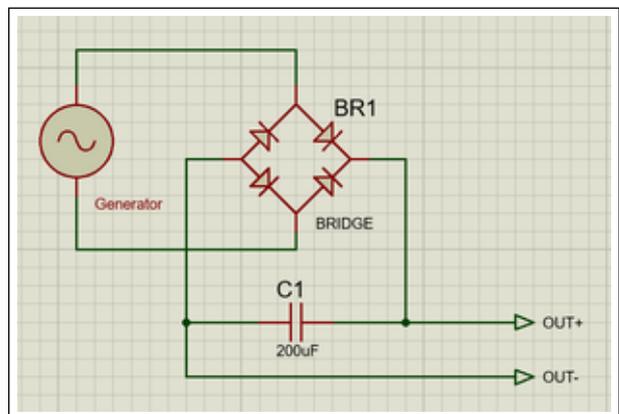


Figure 2: Rectifier Circuit

3. Working Mechanism

This system starts operating whenever load acts on a speed breaker. It works as the input energy of the system. When load acts, its pressure compresses the spring that is holding the speed breaker in its top original position. This causes reciprocating motion of the speed breaker with the help of crank resulting in rotation of the main shaft. Rotation continues while the breaker is compressed down as well the spring that gets relaxed and the breaker moves to the top position. Then the shaft rotates for a specific time period with the help of a crankshaft arrangement mechanism. The main shaft is connected to an auxiliary shaft which are connected to each other with a chain sprocket mechanism. It further increases shaft speed. The gear ratio can be maintained in such a way that the speed of the shaft is maximum which is sufficient to feed into the generator [3]. The rotor rotates along with the rotation of the shaft and flux gets linked with the stator coil and electricity gets induced due to the cause of electromagnetic induction effect. In our case, the induced voltage is dependent on variation of load. The induced raw voltage is passed to the battery through a full wave bridge rectifier. The Prototype system is shown in fig. (3).

4. Mathematical analysis

Applied load on the speed breaker= 25 Kg

Height of uncompressed spring= 23cm

Height of compressed spring =5 cm

Distance travelled by speed breaker= 18cm = 0.18 m

Force applied on speed breaker = 25 * 9.80= 245 N

Work Done= force applied on speed breaker * distance traveled by speed breaker[2]

$$=245 * 0.18$$

$$=44.1 \text{ J}$$

Power developed = Work done / second

$$=44.1 / 60 \text{ (If load is operated for 1 minute)}$$

$$=0.735 \text{ watts}$$

Thus, 0.735 watts of output power is obtained when the device is operated over the speed breaker for a total time period of 1 minute.

Output power generated as measured by multimeter;

Nominal voltage = 6.5 volts

Voltage = 1.74 volts

Current = 0.01 Ampere

Output power = 0.0174 Watt

The range of experimental data varying with load applied is tabulated below.

Table 1: Experimental data of voltages on application of load

SN	Load Applied(Kg)	Voltage (Volts)
1	10	1.20
2	15	1.40
3	20	1.74
4	25	2.34

5. Project Benefits

The benefits of the project is as follows;

- The system serves as a supplementary energy source,
- It uses less floor area, and the traffic is unaffected,
- This system does not require manual supervision during power generation,[3]
- It has a simple construction, easy maintenance, and energy-conserving through a battery

6. Project Limitations

The limitation of the project is as follows;

- Initial installation cost is higher and requires experts' supervision,
- Crossing of Spring Constant due to the passage of any heavy vehicle may cause damage to the system,
- Chance of water leakage inside the system during rainfall.

7. Conclusion

To sum up, Energy has become most essential thing to every human being in this technical era. There is increment in energy demand throughout the world because of the increasing population and energy consuming technology and accessories, there is



Figure 3: Prototype of the system

already an energy crisis in many places of the earth. Soon conventional energy sources like fossil fuels are getting extinct. So, exploring new alternative energy sources is always a great idea and a wise contribution to the community in need. So, our project Energy generation from speed breaker can utilize wasting power into electrical useful energy. We can operate street lights, supply power to traffic lights with the help of generated power. We intended to design a prototype system for energy generation through a speed breaker that could be further developed into a real generation unit. In such a manner, energy can be harnessed from innovative concept implementation to speed breaker and contribute to the solution of evolving energy crisis throughout the world.

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