

An Innovative Method of Electricity Generation from Speed-Breakers of Busy Roadways

Anoop K.A¹, Akash K.C², Amal.M³, Dhilavar Afridi T.V⁴

^{1,2,3,4}UG Student, Dept. of Mechanical Engineering, United Institute of Technology, Tamilnadu, India

Abstract - Electricity generation was first developed in the 1800's using Faraday's dynamo generator. After almost 2 centuries later, the same basic principles are still being used to generate electricity, but on a much larger scale. The primary energy resources are the conventional types and are in limited quantity because they are not renewable, and on the other hand, they create pollution in the atmosphere. Therefore to overcome this problem we need to implement the techniques of optimal utilization of conventional sources for the conservation of energy. This paper includes how to utilize the energy which is wasted when the vehicles pass over a speed breaker. Lots of energy is generated when the vehicle passes over it. We can tap the energy generated and produce power by using the speed breaker as a power generating unit. The principle involved is potential energy to electrical energy conversion. There is a system to generate power by converting the potential energy generated by a vehicle going up on a speed breaker into kinetic energy. This kinetic energy can be converted into mechanical energy of the shaft through rack and pinion mechanism. Then, this mechanical energy will be converted to electrical energy using a generator which will be saved with the use of a battery. The energy we save during the daytime can be used in the night time for lighting street lights. Therefore, by using this arrangement we can save a lot of energy which can be used for the fulfilment of future demands.

Key Words: Power generation, Speed Breakers, Rack and pinion, Energy Conversion, Electricity

1. INTRODUCTION

According to statistics provided by the Ministry of Road Transport & Highways in India show that the length of the national highway by 2012 was 76,818 km. In the year 2002, 58.8 million and in 2004, 72.7 million vehicles were plying on Indian roads. The annual rate of growth of motor vehicle population in India has been almost 10 per cent during the last decade [1, 2]. There is tremendous vehicular growth in India year by year. A large amount of energy is wasted at the speed breakers through the dissipation of heat and also through friction, every time a vehicle passes over it. There is a great possibility of tapping this energy and generating power by making the speed-breaker as a power generation unit. The generated power can be used for the lamps, near the speed breakers. The utilization of energy is an indication of the growth of a nation. For example, the per capita energy consumption in the USA is 9000 KWh (Kilo Watt hour) per year, whereas the consumption in India is 1200 KWh (Kilo Watt hour). One might conclude that to be materially rich and prosperous, a human being needs to consume more and

more energy [3]. 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. 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. By just placing a unit like the "Power Generation Unit from Speed Breakers", so much of energy can be tapped. This energy can be used for the lights on either side of the roads and thus much power that is consumed by these lights can be utilized to send power to these villages.

2. COMPONENT DESCRIPTION

2.1. Springs

Spring is an elastic body whose function is to distort when loaded and to recover its original shape when the load is removed. It cushions, absorbs or controls energy either due to shocks or due to vibrations.

2.2. Rack and Pinion

The rack and pinion used to convert between transverse and rotary motion. The rack is the flat toothed part, while pinion is the gear. Rack and pinion can convert rotary to linear or from linear to rotary motion [6].

2.3. Chain and Sprockets

Roller chain is the type of chain drive most commonly used for transmission of mechanical power. It consists of a series of short cylindrical rollers held together by side links. It is driven by a toothed wheel called sprocket. It is a simple, reliable, and efficient means of power transmission.

2.4. Shaft

It is a rotating element, which is used to transmit power from one place to another place. It supports the rotating elements like gears and flywheels. It must have high torsional rigidity and lateral rigidity.

2.5. Ball Bearings

A roller-element bearing is a bearing which carries a load by placing round elements between the two pieces. The relative motion of the pieces causes the round elements to

roll (tumble) with little sliding. They reduce the friction and transmit the motion.

2.6. Flywheel

The primary function of the flywheel is to act as an energy accumulator. It reduces the fluctuations in speed [7]. It absorbs the energy when demand is less and releases the same when it is required.

2.7. Spur Gear

It is a positive power transmission device with a definite velocity ratio. It preferred for adjusting some linear misalignment. It should have high wear and tear, shock-absorbing capacity.

2.8. Generator

It is a device, which converts mechanical energy into electrical energy. The generator uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current through "Faraday's law of electromagnetic induction".

3. BLOCK DIAGRAM

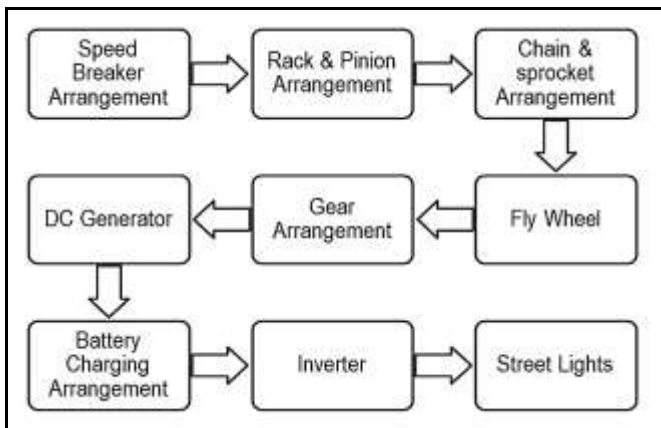


Fig -1: Block Diagram for Energy flow

4. DESIGN LAYOUT

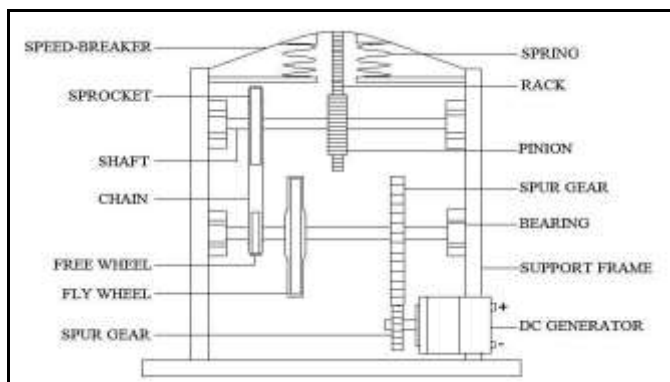


Fig -2: Design Layout for Speed- Breaker

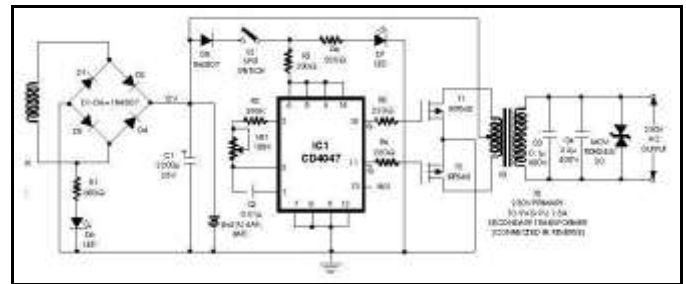


Fig -3: Electric Circuit for Storage and Supply of Electricity

5. WORKING PRINCIPLE

The project is concerned with the generation of electricity from speed breakers-like set up. The load acted upon the speed-breaker setup is thereby transmitted to rack and pinion arrangements. Here the reciprocating motion of speed-breaker is converted into rotary motion using the rack and pinion arrangement. The axis of is coupled with sprocket arrangement. The sprocket arrangement is made of two sprockets. One larger size and the other of smaller size (freewheel). Both the sprockets are connected by means of a chain which serves in transmitting power from the larger sprocket to smaller sprocket. As the power is transmitted from a larger sprocket to smaller sprocket, the speed that is available at the larger sprocket relatively multiplied at the rotation of smaller sprocket. The axis of the smaller sprocket is coupled to a flywheel. The flywheel is coupled to the shaft at the axis of the smaller sprocket. Hence speed that has been multiplied at the smaller sprocket wheel is passed on to this flywheel of larger dimension. The smaller sprocket is coupled to the larger flywheel. So as the wheel rotates at the multiplied speed of smaller sprocket, sprocket following the larger sprocket still multiplies the speed to more intensity. Hence, although due rotary motion achieved at the larger sprocket wheel is less, as power is transmitted to the flywheel, finally the speed is multiplied to a higher speed. This speed is sufficient to rotate a shaft connected to a generator. The rotor (shaft) provide sufficient energy to rotate the generator, thereby produces the DC current. This current is now sent to the storage battery where it is stored during the daytime. This current is then utilized in the nighttime for lighting purposes on either side of the road to a considerable distance. It is an Electro-Mechanical unit. It utilizes both mechanical technologies and electrical techniques for the power generation and its storage.

6. ENERGY ESTIMATION

When the vehicle moves over the speed breaker, speed breaker reduces its speed. As these breakers have a little height it gains an increase in its potential energy. A vehicle weighing 1,000kg passes over the system it pushes the damper to a depth of 10 cm it can produce approximately 0.98-kilowatt power (ideally). So from one such speed breaker on a busy highway, where about 100 vehicles pass every minute, about one kilowatt of electricity can be produced every single minute. This type of energy is a non-

conventional resource or renewable energy. While moving, the vehicles possess some kinetic energy and it is being wasted. This kinetic energy can be utilized to produce power by using a special arrangement called POWER HUMP. It is an Electro-Mechanical unit [4]. It is a mechatronic type of arrangement. The amount of electricity consumed in one night by all the street lights around Chennai city (India) is equal to the consumption of electricity in a remote village for one month and 14 days [5]. The design of speed breakers was developed long ago but only utilized by few nations, as there were limitations of speed breaker power generators. These power generators can be classified according to their mechanism and the type of power generated through it.

Let consider,

The mass of a vehicle = 1000 Kg (Approximately)

Height of speed brake = 10 cm

Work done = Force x Distance

Force = Weight of the Body

$$= 1000 \text{ Kg} \times 9.81 = 9810 \text{ N}$$

Distance travelled by body = Height of speed brake

$$= 10 \text{ cm}$$

$$\text{Output power} = \text{Work done/Sec} = (9810 \times 0.1)/60 \\ = 16.35 \text{ W}$$

Power developed for 1 vehicle passing over the speed breaker arrangement for one minute is 16.35 W

Power developed for 60 minutes (1 hour) = 16.35 x 60

$$= 981 \text{ W}$$

Power developed for 24 hours = 981 x 24

$$= 23.544 \text{ KW}$$

This power generated by vehicles is more than sufficient to run four street lights in the night.

7. IMPLICATIONS OF USING SPEED BREAKER

The power generated through a speed breaker mechanism can be considered a renewable source which does not pollute the environment. Below are the advantages and challenges of using speed breaker mechanism for power generation.

7.1. Advantages of Using Speed Breaker Power Generator

- ▶ Require simple construction methods.
- ▶ Free from all types of pollutions.
- ▶ It is economical and easy to install.

- ▶ Maintenance cost is low.
- ▶ This concept is quite promising due to its good efficiency as well as energy recovery criteria.
- ▶ No fuel transportation problem.
- ▶ No consumption of fossil fuel which is nonrenewable.
- ▶ No manual work necessary during generation.
- ▶ Energy available all year round.
- ▶ We can use it at all places according to the desired design.

The Indian Institute of Technology, IIT, Guwahati has evaluated the machine and recommended it to the Assam ministry of power for large-scale funding. IIT (Indian Institute of Technology) design department says it is a “very viable proposition” to harness thousands of megawatts of electricity untapped across the country every day, [6]. It is therefore recommended that the Nigerian Ministry of power should also begin implementation of this technology to improve power generation across the country. A storage module like an inverter will have to be fitted to each such rumble strip to store this electricity. The cost of electricity generation and storage per megawatt from speed-breakers will be nearly USD500,000 as opposed to about \$1.2million in thermal or hydropower stations [6].

7.2. Challenges

- ▶ Selecting a suitable generator.
- ▶ Selection of springs.
- ▶ Achieving a proper balance of speed and torque.
- ▶ Such speed breakers can be designed for heavy vehicles, thus increasing input torque and ultimately output of the generator and hence it will not work with the lightweight vehicle.
- ▶ Require more suitable and compact mechanisms to enhance efficiency.
- ▶ We have to check mechanism from time to time in a short span of period.
- ▶ Because of Rainwater, it may get damaged.

8. CONCLUSION

In the coming days, demand for electricity will be very high as it is increasing every day, speed breaker power generator will prove a great boom to the world in the Future. The Aim of this project is to introduce another innovative method of green power generation in order to contribute toward developing the world by enriching it with the utilization of available resources in a more useful manner. Now the time has come for using these types of Innovative ideas and it should be brought into practice. It is suggested that further developments should be done to minimize the above-mentioned challenges. By using the concept of power generation new ideas should be introduced which would help in the reduction of friction and increase the efficiency of the generators.

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