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Research Article

# Power Generation from Speed Breaker by Rack and Ratchet Mechanism

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***Abstract***

*The cheapest and new source of energy is obtained by the conversion of one form of energy into other. The renewable sources of energy become more popular because of nonpolluting and easily available from the nature. One such energy is explained in this paper. The number of vehicles passing over the speed breaker on the road is increasing day by day. Such speed breakers are designed for heavy vehicles, thus increasing input torque and ultimately increasing the power as output. There are many suitable and compact mechanisms to enhance efficiency. The generated power can be used for the lamps near the speed breakers and this will be a great boon for the rural villages too. In this paper it is mainly focused on the working of the newly developed rack and ratchet (pinion) mechanism which is used to develop the power from speed breakers, its practical implementation.*

***Key Words****: Speed breaker, renewable energy, electrical power, rack and ratchet mechanism*

## 1. Introduction

An energy crisis is any great bottleneck (or price rise) in the supply of energy resources to an economy. It usually refers to the shortage of oil and additionally to electricity or other natural resources. An energy crisis may be referred to as an oil crisis, petroleum crisis, energy shortage, electricity shortage electricity crisis. While not entering a full crisis, political riots that occurred during the 2007 Burmese anti-government protests were initially sparked by rising energy prices. Likewise the Russia-Ukraine gas dispute and the Russia-Belarus energy dispute have been mostly resolved before entering a prolonged crisis stage. Market failure is possible when monopoly manipulation of markets occurs. A crisis can develop due to industrial actions like union organized strike sand government embargoes. The cause may be ageing over-consumption, infrastructure and sometimes bottlenecks at oil refineries and port facilities restrict fuel supply (Alam, M *et al*. 1983). Iraq is third in the world for its oil reserves. However some observers have stated the global oil production peak occurred in December 2005. If this is correct it is also to blame.

Central Asia energy crisis caused by abnormally cold temperatures and low water levels in an area dependent on hydroelectric power. South African electrical crisis Solution for Energy Crisis next time on the roads, don't scoff at the speed-breakers. They could actually light up small villages off the highway. Generally when vehicle is in motion it produces various forms of energy like, heat energy, wind energy etc., all these energies can't make use of is just the wastage of energy that is abundantly available around us.

In this paper it is mainly focused on the principle of "Potential Energy to Electrical Energy Conversion". Potential energy can be thought of as energy stored within a physical system. This energy can be released or converted into other forms of energy, including kinetic energy. It is called potential energy because it has the potential to change the states of objects in the system when the energy is released. If h is the height above an arbitrarily assigned reference point, then Kinetic energy of an object is the extra energy which it possesses due to its motion. It is defined as the work needed to accelerate a body of a given mass from rest to its current velocity. Having gained this energy during its acceleration, the body maintains this kinetic energy unless its speed changes. Negative work of the same magnitude would be required to return the body to a state of rest from that velocity. In this paper it is explained the working of a mechanism to generate power by converting the potential energy generated by a vehicle going up on a speed breaker into kinetic energy. When the vehicle moves over the inclined plates, it gains height resulting in increase in potential energy, which is wasted in a conventional rumble strip (Bhatia, R 1988). When the breaker comes down, they crank a lever fitted to a ratchet-wheel type mechanism (an angular motion converter). This in turn rotates a geared shaft loaded with recoil springs. The output of this shaft is coupled to a dynamo to convert kinetic energy into electricity. A vehicle weighing 1,000 kg going up a height of 10 cm on such a rumble strip produces approximately 0.98 kilowatt power.

## 2. Scope of the Present Work

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The utilization of the electrical energy is goon increasing with the growth of population. The United States of America (USA) is the world's second largest producer and consumer of electricity (Cecelski, B *et al,* 1979). It consumes about 20% of the world's supply of electricity. This is given by the US DOE Energy Information Administration/Electric Power Annual 2011.

Total electrical energy consumption in 2011 was 4,138 Billion kWh (B kWh). Per capita consumption from the electrical grid in the same year was 13,187 kWh and is essentially the same as a decade ago-2001.

Total Consumption in the peak year of 2007 was 4,184.5 B kWh up from 3,836 in 2000. The per capita average annual domestic electricity consumption in India in 2009 was 96 kWh in rural areas and 288 kWh in urban areas for those with access to electricity, in contrast to the worldwide per capita annual average of 2600 kWh and 6200 kWh in the European Union(Goldemberg, J. *et al.* 1985). India's total domestic, agricultural and industrial per capita energy consumption estimate varies depending on the source.

India currently suffers from a major shortage of electricity generation capacity, even though it is the world's fourth largest energy consumer after United States, China and Russia. The International Energy Agency estimates India needs an investment of at least $135 billion to provide universal access of electricity to its population.

India is population growing country; therefore the utilization of electrical energy will also increase (Reddy, S 1990; Reddy, A K N *etal*, 1994). There are number of resources for the production of electric energy but all are commercially high. It is essential to produce the electrical energy with the existing natural resources. In this process, the production of electrical energy with the sun (solar energy) is one. But the investment cost is more. Similarly, the cost of production of electrical energy with wind, tide etc., is high. Therefore the proposed concept with simple arrangement, it is easy to produce electrical energy for the working of street light, lamppost, street and the cost is very less.

### 3. Development and Working of the Model

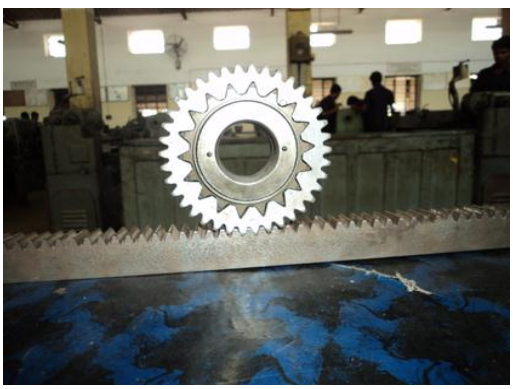

**Figure 1** Rack and ratchet as pinion mechanism

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. It utilizes both mechanical technologies and electrical techniques for the power generation and its storage. The power hump is a dome like device likely to be speed breaker. The rack and ratchet is used to convert the rotary in to linear motion as shown in Figure1.

The rack is the flat, toothed part, the ratchet is the gear. The diameter of the gear determines the speed that the rack moves as the pinion turns. Rack and pinions are commonly used in the steering system of cars to convert the rotary motion of the steering wheel to the side to side motion in the wheels. A ratchet is a mechanical device that allows continuous linear or rotary motion in only one direction while preventing motion in the opposite direction. Rack and ratchet gears give a positive motion especially compared to the friction drive.

The line diagram of the proposed model is shown in Figure 2.

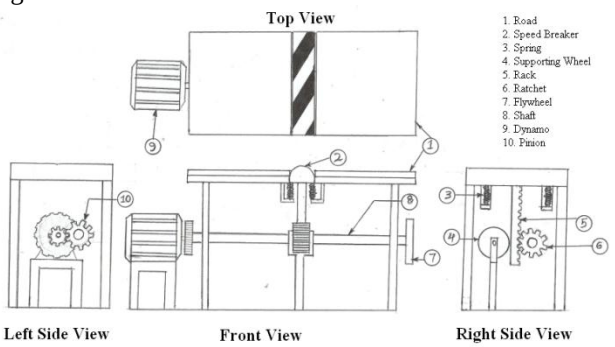


**Figure 2** Schematic line diagram of the proposed work

Whenever the vehicle is allowed to pass over the dome it gets pressed downwards then the springs are attached to the dome is compressed and the rack which is attached to the bottom of the dome moves downward in reciprocating motion. Since the rack has teeth connected to gears, there exists conversion of reciprocating motion of rack into rotary motion of gears but the two gears rotate in opposite direction. A flywheel is mounted on the shaft whose function is to regulate the fluctuation in the energy and to make the energy uniform. So that the shafts will rotate with certain R.P.M., these shafts are connected through a belt drive to the dynamos, which converts the mechanical energy into electrical energy. The conversion will be proportional to traffic density. Whenever an armature rotates between the magnetic fields of south and north poles, an E.M.F (electro motive force) is induced in it. So, for inducing the E.M.F armature coil has to rotate, for rotating this armature it is connected to a long shaft. By rotating same e.m.f, is induced, for this rotation kinetic energy of moving vehicles is utilized. The Figure 3shows the model developed and it's working.

The Figure 4 shows the generation of the power from the developed model. When the vehicle pushes the speed breaker then the speed along with rack comes down. The rack pushes down the rachet type pinion to which the shaft is attached. End of the shaft the flywheel is attached with which the dynamometer attached. From the dynamometer the output power is generated (the bulb is glowing as shown in Figure 4).

**Figure 3** The assembly of the model

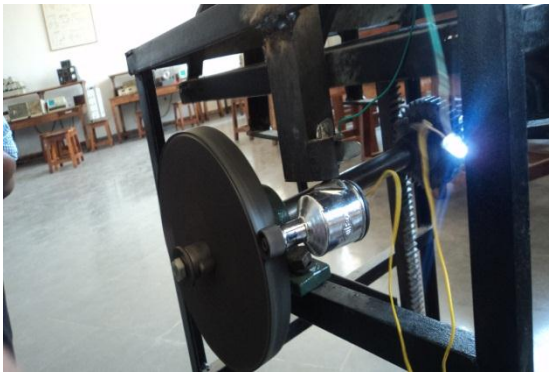

**Figure 4** The power output from the developed speed breaker arrangement

## 4. Model Calculations

*4.1 Theoretical Calculation (Approximate)*

Let us consider, The mass of a vehicle moving over the speed breaker = 150Kg (Approx.)

Height of speed brake =10 cm

Work done=Force x Distance

where,

Force = Weight of the Body
= 150 Kg x 9.81m/s$^2$
= 1471.5 N
Distance travelled by the body = Height of the speed brake =10 cm
Output power= (1471.5 x 0.1)/60
= 2.452 Watts (For One pushing force)
Power developed for 1 vehicle passing over the speed breaker arrangement for one minute
= 2.452 watts
Power developed for one hour =147.12 watts
Power developed for one day = 3.531 kw

*4.2 Experimental Calculations*

The generated output voltage in three pushing forces of speed breaker = 6 kv
Current in the circuit in three pushing forces of speed breaker = 0.5 amps
As per ohm's law
P = V*I
= 6*0.5
P = 3 kw

## Conclusions

The significant conclusions that may be drawn based on the present work may be summarized as follows:

i. Model study is done and it is found to give a satisfactory results.
ii. The mechanism proposed is much simpler and continuously produces the electrical power.
iii. The produced electrical energy is a renewable energy which is pollution free.
iv. Model calculation is done and observed good results.

## Advantages

Using this technology one can get the following benefits:

- Low maintenance cost
- Low installation cost
- Pollution free power generation.
- No manual work necessary during generation.
- Simple construction, mature technology, and easy maintenance.
- No fuel transportation problem.
- Energy available all year round.
- No consumption of any fossil fuel which is non-renewable source of energy.

## Applications

The generated power is stored in the battery; one can use this charge to various purposes. Mainly the generated power is used in two aspects.

*Street Lights*

A Street light, lamppost, street lamp, light standard, or lamp standard is a raised source of light on the edge of a road or walkway, which is turned on or lit at a certain time every night. Modern lamps may also have light-sensitive photocells to turn them on at dusk, off at dawn, or activate automatically in dark weather.

*Traffic Lights*

Traffic lights, which may also be known as stoplights, traffic lamps, traffic signals, signal lights, robots or semaphore, are signaling devices positioned at road

intersections, pedestrian crossings and other locations to control competing flows of traffic. Traffic lights were first installed in 1868 in London, and today are installed in most cities around the world.

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