

## Analysis of Speed Breaker Mechanism for More Effective Electricity Generation

Md. Rokonzaman<sup>1</sup> and Md. Hossam-E-Haider<sup>2</sup>

<sup>1,2</sup>Department of Electrical, Electronic and Communication Engineering

<sup>1,2</sup>Military Institute of Science and Technology (MIST)

Email: ragib\_isme@yahoo.com<sup>1</sup>

### Abstract

*Modern industrialized civilization mostly depends on energy in the form of electricity. It is going to refractory to produce huge amount of energy. Since the population is rising, the environment is going unbalance by pollution, global warming and different kinds of deregulation of energy usage and wastage. Speed breaker is a newest source of technology to renew the wastage energy of vehicle to electrical energy during the passing time through every speed breaking hump. This paper investigates and analysis two practically implemented process of electricity generation from speed breaker named roller mechanism and rack-pinion mechanism. It can be surely effective to reduce the huge power crisis in the near upcoming days for rapidly development of infrastructure especially for developing country like Bangladesh. Where population is thriving dramatically and vehicles are flourishing proportional with the ascending rate of population. Ultimately the increased vehicle is rising up the wastage of energy and this mechanism picks the wastage energy for renew it to electrical energy by thinking out of box for generation of electricity. Though the amount of electricity depends on the number of vehicle pass over the speed hump and weight of the carrying vehicle which drops on the speed breaker and how much efficiently the system is designed then two different research paper has shown the huge capacity to generate electricity. This paper represents a comparative study of both mechanism to find out the best one from them and in-depth analysis will suggest a combined mechanism.*

**Keywords:** Electricity generation, rack-pinion mechanism, roller mechanism, renewable sources.

### 1. Introduction

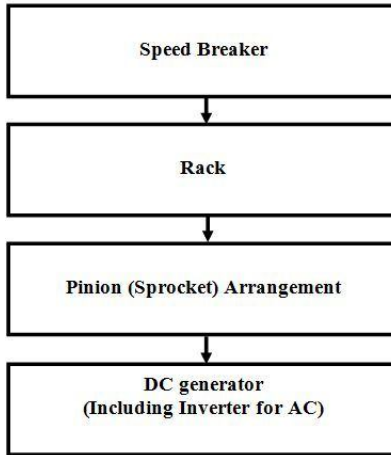
Highly increased living standard and rapidity of industrialization causes the demand of electricity and it's raised dramatically, but the generation of electricity does not raised in the same scale as demand. In Bangladesh only about 32% of the total population has access to use electricity and 6% to natural gas. But in rural area only 22% has electricity [1]. Though from year 1850-2005 production and use of traditional energy increases more than 50% with a total of approximately 0.2 billion to 11.4 billion toe (IEA, 2007), mostly in industrialized nations [2]. To compete with this demand alternate thinking of energy sources are getting popular day by day. Renewable energy consist the concept which synchronizes with solar, wind, biogas, biomass; tidal etc. energy and these are cooperative to meet the demand. Though this energy sources are not highly capable to minimize the shortage of electricity generation. Recently a new technique is introduced called speed breaker technology to produce electricity from the speed breaker used in road and high ways. Main theme of this technique is to convert mechanical energy to electrical energy. Different mechanisms like rack pinion, roller, crank-shaft are used to enhance electricity from speed breaker [3]-[6]. Roller fitted in the road and vehicle passing over the speed breaker are the source of generating electricity [6]. Another one is efficient energy generating system using speed breaker with rack-pinion mechanism [7]. Both of the mechanisms are experimentally implemented and effective. This paper represents a comparative study of two techniques and proposed a combined new mechanism.

### 2. Methodology

This section is introducing the Rack-Pinion and Roller mechanism respectively.

#### 2.1 Rack Pinion Mechanism

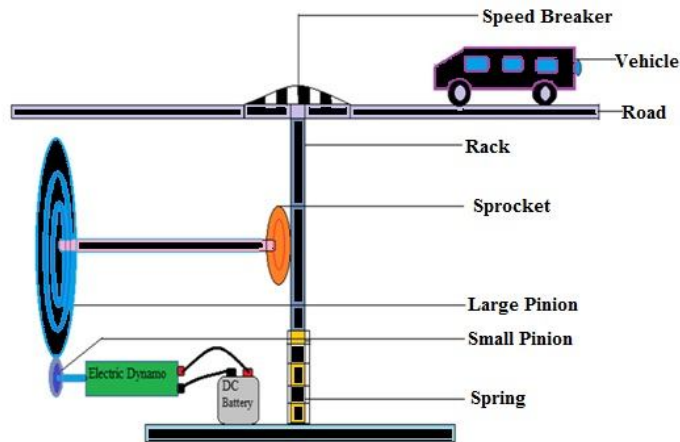
Fig. 1. Shows block diagram of the rack-pinion mechanism. Here Speed breaker will be in the top of whole system, this will directly connected with a rack. Rack is designed with many mortise, depending on it the pinion is designed.



**Fig. 1.** Block diagram of rack-pinion mechanism

In this method one rack and two pinion is used, by client choice it can be increased and it will provide more rotation to the shaft of the generator. In the end of rack a spring is connected to force it reverse and a small sprocket is placed with it to rotate another large pinion. This large pinion helps to rotate the generator shaft directly. This system produces DC electricity, if required for ac electricity an inverter can be used.

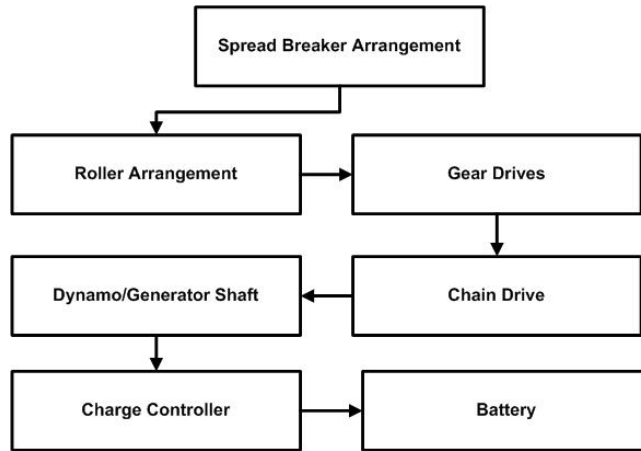
### 2.1.1 Constructional Details



**Fig. 2.**Equipment used in rack-pinion techniques [7].

Fig. 2.Represents all the parameters used in this techniques. When the vehicles passes over the speed breaker, rack will continuously moves to the downward direction and directly rotates the sprocket and pinion respectively. Since the pinion is directly connected to the shaft of the DC generator, it will generate electricity. The position and time of the rack in downward direction depend on the speed and transitional period of stay of moving vehicle over the speed breaker [7].

### 2.2 Roller Mechanism



**Fig. 3.** Block diagram of roller mechanism

Fig.3. shows a single block diagram to represent the whole system of roller mechanism. Here, the rotational energy from roller is converted to mechanical energy by chain drive then it converted to electrical energy by dynamo and finally it stores in the battery. From battery or directly we can connect this energy sources to the load.

### 2.2.2 Constructional Details



**Fig.4.** Parameters are used in roller mechanism [8].

Fig.4. represents all the parameters are used to implement the total system. The height of the speed breaker or the roller is 8 inch and there is a minimum gap between the speed breakers and the roller to obtain maximum rotation. Roller is iron made but outer surface is covered by rubber. Gear ratio is 1:4 and its mesh with another toothed part of the chain drive. Chain drive is a way to transmit the mechanical energy from roller to the shaft of the dynamo. Dynamo directly generates electrical energy to output, by converting the mechanical energy as input. Battery stores the electrical energy and helps to provide energy in no vehicle passing time.

### 3. Comparison of Two Methods

Rack and pinion method is meant to extract the mechanical energy of moving vehicles that converts into energy through rack-pinion arrangement. Produced Energy from the vehicle passing over the speed breaker drives the shaft that acts as causal agent for shaft rotation of DC generator. In roller shaft method the wasted energy is generate electricity by roller mechanism. Rack and pinion method depends on spring whereas roller shaft does not. Usage of spring sometime might result in rustic problem. The major

disadvantage of multiple sprocket freewheel is that the drive-side bearing is located inboard of the free wheel. This might further result in stress on the axel. As a result of which the axel might bend or even break. Table 1. Shows a comparison between the two methods:

**Table 1.** Comparison between rack-pinion and roller mechanism

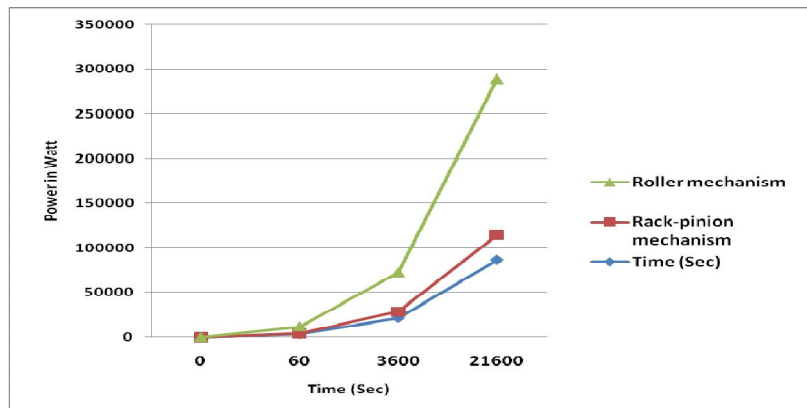
Sl. No	Parameters	RollerMethod	Rack-PinionMethod
1	Cost	Cheap	Moderate
2	Mechanismsetup	Veryeasy	Difficult
3	Maintenance	Highly required	Less required
4	Efficiency	~50%	~70%
5	Design	Easy todesign	Depends upon weight Sustaining capacity
7	Height	5.08 cm	12 cm
6	Dependency	Mostly in roller	Mostly in spring

### 3.1 Data Comparison

In rack-pinion mechanism, when one vehicle passing over the speed breaker in 60 second, it generates 19.62 watts [7]. In Roller mechanism, if one vehicle passes in 4 sec over the speed breaker power generated 8.1 watt [8]. For 60 sec it increased to 121.5 watts. Let consider in 24 hour is continuous functional time of the speed breaker. Table 2. Shows a tabular form of the different power generated by two distinguish method.

**Table 2.** Comparison between two generated powers by two methods

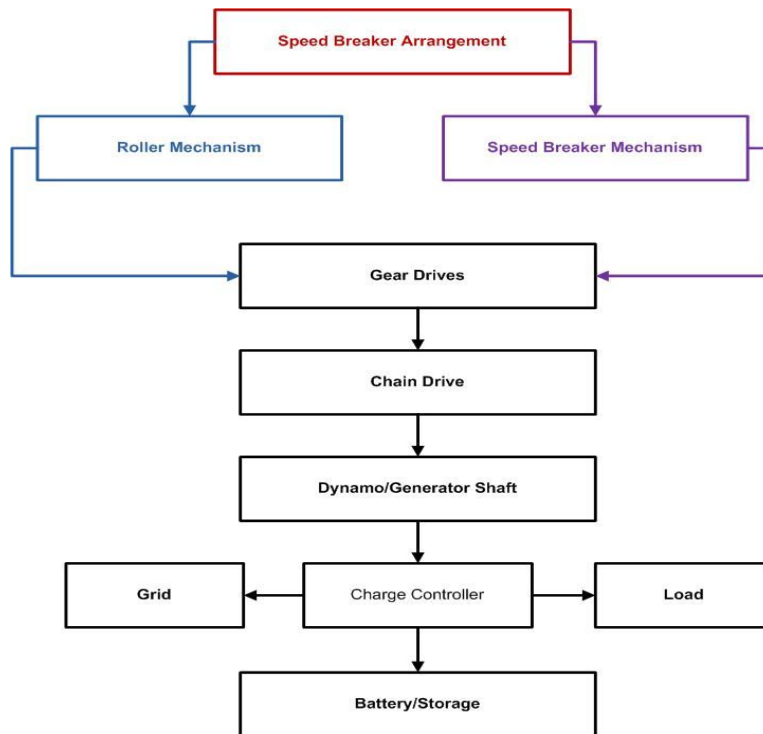
<i>Time(Sec)</i>	<i>Power in rack-pinion Mechanism (watts)</i>	<i>Power in roller Mechanism (watts)</i>
60(1 min)	19.62	121.5
3600 (60 min)	1177.2	7290
21600 (6 hour)	7063.2	43740
86400 (24 hour)	28252.8 (28.25 kW)	174960 (174.96 kW)



**Fig. 5.** Graphical comparison of power Vs time between two mechanisms

Fig. 5. Represent graphical data of generated power in 24 hour. Here, 6 hour is considered as useful time of the speed breaker. This plot is showing that power generation from rack-pinion mechanism is less than roller mechanism. To get more efficient power, we can combine both of the mechanism. This paper is proposed a combined mechanism to make a fruitful techniques using speed breaker.

#### 4. Proposed Mechanism



**Fig. 6.** Block diagram of proposed mechanism

Fig. 6. Show proposed block diagram of combined mechanism. It will increase the efficiency of the whole system because of integrating two mechanisms but it's true that maintenance will be hard. Charge controller will provide a smooth output which can be employed to grid or directly load as per need base. Authors are trying to practically implement this idea of combined mechanism and this paper is a partial part of it.

#### 5. Conclusion

Utilizing non-conventional energy sources has received much attention in Bangladesh for electricity generation. To manage the electricity crisis and global warming impact. This paper proposed a combined mechanism of rack-pinion and roller shaft. Rack-pinion techniques are easy to implement, economical too. Besides, roller shaft techniques are difficult to design but generate huge number of electricity. Combination of these two mechanisms can therefore be more effective to generate electricity for a protracted time. Although initial results have verified the increased electricity generating capacity, practically further implementation and analysis will be considered in future work. The combine mechanism will be able to reduce some lacking for design of each single mechanism and surely it will raise the generation capacity.

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