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138. Speed Breaker Power Generator

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Abstract

It is very significant to design pollution free energy generation system. Speed breaker Power Generator (SBPG) is the most emerging technique which produces electrical power with minimum input. An experimental study to generate the electricity by SBPG is described in this paper. In this system, a rack and pinions mechanism is used for the production of electricity. When a car reaches on the speed breaker, the rack moves downward to generate linear to rotary motion using pinions. The rotary motion is transferred to DC generator which generates DC power which is stored in batteries same as in solar technology. The generated power can be used for the domestic purpose or commercially, which are present near the speed breaker. This examined that SBPG is generating 273.24W on single push under the application of 400kg. In an hour, passing 100 cars of 400kg can generate 54.59 kWh. This mechanism utilizes both downward as well as the upward motion of the rack.

Keywords: *Power generation, speed breaker, rack and sprocket pinion.*

1. Introduction

During last few decades, electrical energy is the basic requirement of human beings. The ratio of electricity requirement is increasing day by day. But we know that the resources for power generation are limited, and this has caused the energy crisis. The increasing power demand results reduce in conventional resources for power generation and increase the pollutants emissions. It is a need of time to think about non-conventional energy resources or renewable energy resources which are eco-friendly to the environment. In order to minimise the emission of greenhouse gases, renewable energy technologies are widely used for electricity generation. Solar and wind technologies are frequently used for electricity generation. Fig. 1 is rearranged in MS Excel that shows power generation in Pakistan by each sector [1].

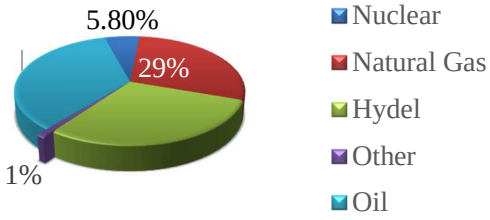

Fig. 1. Power generation in Pakistan by sector in 2014

Speed-breakers are movement quieting devices generally introduced to decrease speed related mischances [2]. Speed breakers are intended to be rolled over at a foreordained agreeable rate while bringing on surpassing inconvenience at higher rates. The diminishment in normal vehicular speed essentially enhances the security of individuals in the neighbouring territories. These devices are most common in developing countries [3]. Consequently, speed-breakers are regular in numerous developing countries, including India, Chile, Egyptian Empire, Ghana and Pakistan [4].

The flow of traffic on rushed load is control by the use of Speed Breakers. The annual rate of motor

vehicle growth in Pakistan is increasing day by day. The weight of vehicles in term of potential energy can be utilized for electricity generation purposes [5]. In this paper, we developed a method of generating electricity using speed breaker on the roads. To obtain maximum power, the flow of moving vehicles is very important. In this mechanism, a rack and pinions are used. This mechanism converts the kinetic energy of moving vehicles into electric energy with the help of speed breaker on the roads. This is generating many kilowatts of power by using downward as well as the upward motion of rack. Downward motion is caused by load and upward motion is due to restoring force utilizing store power in springs.

2. Methodology of working

When a car reaches on speed breaker, rack moves downward to generate linear motion [6]. Two pinions are attached to a rack which converts the linear motion of rack into rotary motion. Both pinions have unidirectional motion, like as bicycle sprocket. Two gears are mounted on pinion shaft's to transfer mechanical power to the common shaft having one gear. At final shaft, a flywheel is used to provide uniform motion. A belt is used to transfer mechanical motion of the common shaft to DC generator. The complete gear box is dipped in lubrication oil sump to minimize frictional losses. There are no chances of slipping between rack and pinions due to guide slots. DC generator generates DC power which is stored in batteries same as in solar technology [7]. The generated power can be used for the domestic purpose or commercially, which are present near the speed breaker.

2.1. Rack and pinion mechanism

The rack and pinion mechanism in AutoCAD 2013 is illustrated in Fig 1. Fig 1(a) shows that when a car reaches on the speed breaker, it applies its weight on the speed breaker. The rack is connected with the speed breaker and two pinions mesh across the rack. Due to the weight on the speed breaker, rack moves downward and linear motion is obtained. It rotates the pinions which are attached on the both sides of the rack. At this point, linear motion of rack converts into angular motion. Only right sided pinion transfer power and pinion mashed on left side keep rotating without transfer of power. Fig 1(b) and Fig 3 represent that four springs help the speed breaker to move upward and thus only left sided pinion transfer power and pinion mashed on right side keep rotating without transfer of power a complete cycle of linear to rotary motion is obtained. The pinions were designed to work as sprocket of the bicycle. At load, one side of pinion engages and another side of pinion disengage. Similarly, restoring force engages another side of the pinion and first side of pinion disengage. They transfer power in forward as well as the reverse stroke of speed breaker respectively and provide continuous angular motion.

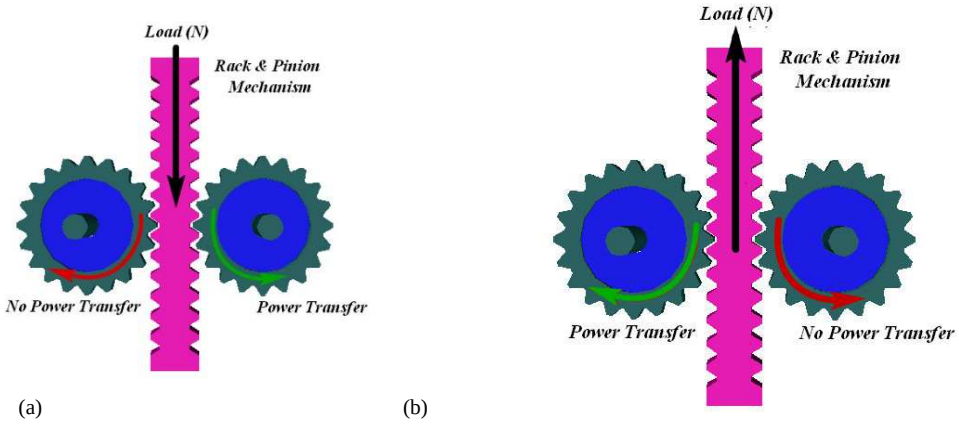

Fig. 1. Right sided pinion power transfer (a) and left sided pinion power transfer (b).

Fig 2 display working principle of rack and pinion mechanism and internal mechanism of SBPG in AutoCAD 2013. Gear of different teeth and diameter are mounted on both pinion's shaft to maximize the number of revolutions. A gear mounted on the common shaft is placed between both pinion's shafts. The flywheel is mounted on the common shaft. It keeps the rotation of the shaft in uniform angular motion. It stores the jerky rotations of pinion's shaft. Mechanical rotation is used to rotate the shaft of the generator through a belt. The shaft of maximum RPM (common shaft) is coupled with DC generator. A DC

generator produces direct current [8]. According to Faraday's law of induction when coil moves inside the magnetic field, it generates electric current [9]. It rotates the rotor of the generator and in this way, the electricity is generated.

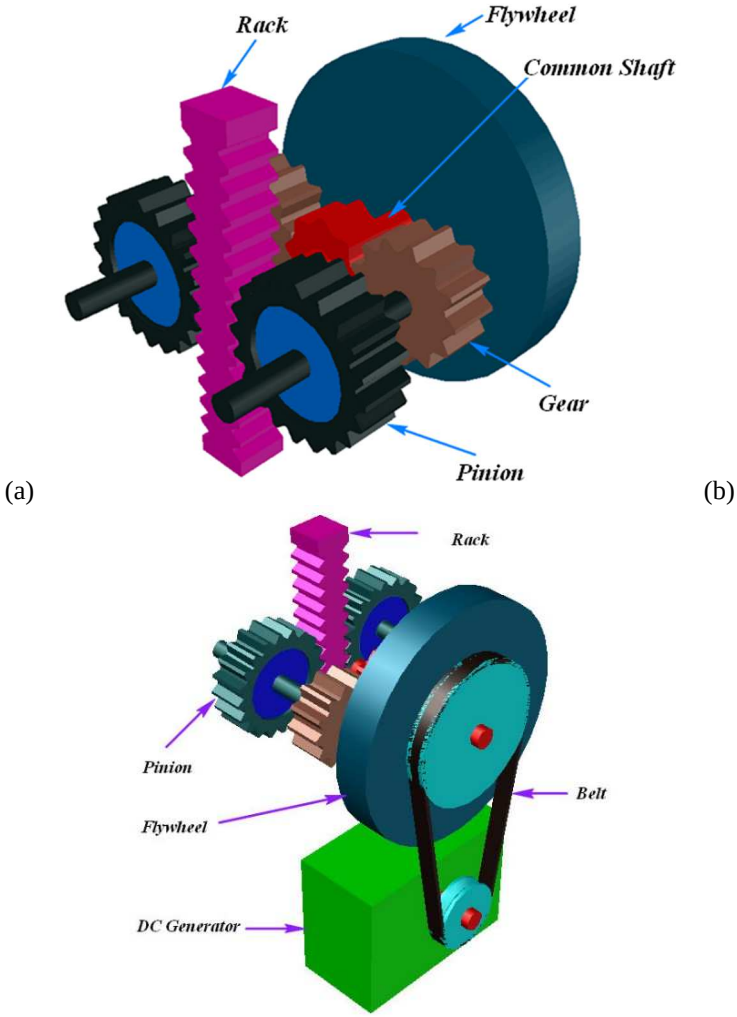

Fig. 2. Rack and pinion mechanism (a) 3D internal mechanism of SBPG (b).

Fig 3 represents the 3D model of SBPG mechanism is in AutoCAD 2013. Fig 3(a) identify 3D model by offing road and speed breaker. Four springs [10] are used to provide the upward motion. Utilizing energy (under the application of restoring force when the load is removed) rack moves upward and regain its original position. Two Support platforms for spring are welded to the frame to support the springs. Three supporting bars support whole mechanism. Guide slots lead speed breaker in the straight line and save it from trouble. Rubber beadings are used around the edges of SBPG to prevent water and dust from entering into it [11]. Fig 3(b) illustrate the complete 3D model of SBPG mechanism.

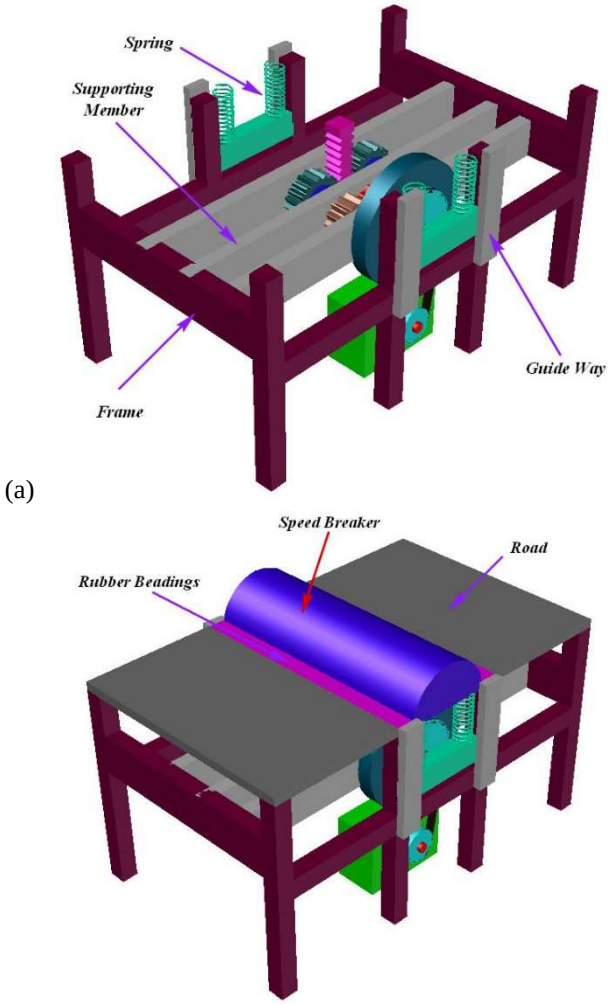

Fig. 3. 3D model of SBPG by offing road and speed breaker (a) 3D Model of SBPG (b).

2.2. Prototype Model

Fig 4 represents a prototype model of SBPG system. This was developed by our team for the purpose of participation in DICE Automotive 2015. We presented this model in DICE Automotive 2015 SSME NUST Islamabad.

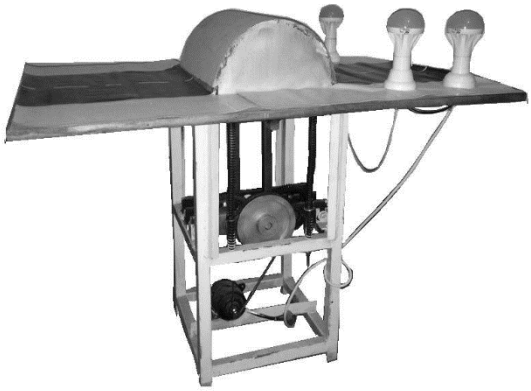

Fig. 4 Prototype model of SBPG

3. Experimental study and results

Consider 100 cars of mass 400kg pass over a speed breaker in an hour. The height of rack is 14cm, the diameter of the final pulley is 18mm and having revolution speed (N) is equal to 37 RPM. Down word

motion of speed breaker is due to the weight of moving the vehicle and upward motion of speed breaker is take place due to the utilization of energy from springs. Each car pushes speed breaker two times.

$$\text{Force} = F = mg \quad (1)$$

$$F = 400 \times 9.8 = 3920N$$

$$r = 9mm$$

$$T = r \times F \text{ (Nm)} \quad (2)$$

$$T = 9x\ 10^{-3} \times 3920$$

$$T = 35.28 \text{ (Nm)}$$

$$P = T.\omega \quad (3)$$

$$P = 35.28 \times 2\pi N/60$$

$$P = 35.28 \times (2 \times 3.14 \times 37)/60$$

$$P = 136.62 \text{ W}$$

Total generated in forward and reversed stroke.

$$P = 2 \times 136.62 \text{ W}$$

$$P = 273.24 \text{ W}$$

Revolution in one minute = 200/60 = 3.33rev/min

Power generated per minute = 273.24 × 3.33

= 909.89 W (minute)

Power generated in one Hour = 909.89 x 60

= 54.59 KW (hour).

Different masses are applied on the speed-breaker and the measured the electrical power. Fig 5 shows the linear relationship between the load and produce power.

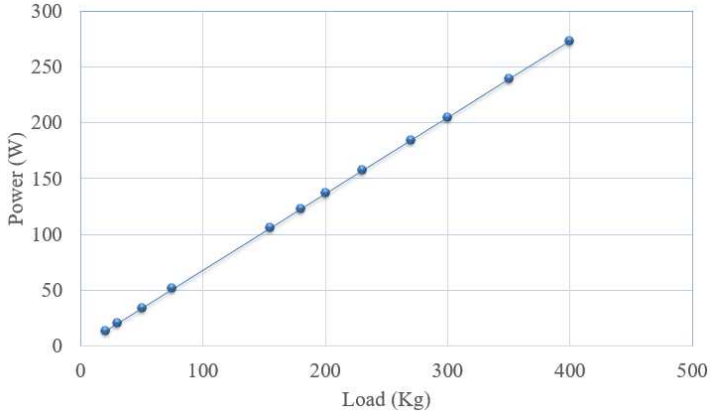

Fig. 5. Power variation due to load (kg)

4. Conclusions

This is generating many kilowatts power by using downward as well as the upward motion of rack. With the help of speed breaker mechanism, linear motion of rack is converted into rotary motion of pinion and thus is used to rotate the shaft of DC generator. It generates 273.24 watts with 400kg of load and 14cm of the height of the rack. DC voltages charge the batteries during the passage of moving vehicles. Using inverter (DC to AC conversion), we will be able to use batteries power for other useful applications. It can be implemented on the toll plazas, highways. Guide slots and lubricating oil sump is required to minimise friction losses. The initial cost of this arrangement is high but after the first cost, it will be free energy system.

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