

Power Generation by Moving Vehicles on Speed Breaker Using Bicycle Pedal Mechanism

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Abstract. The Generation and storage of electricity is a prime concern in this modern era of development and innovations. Currently, several eco-friendly and conservative strategies are available with different approaches for the generation of electricity. However, development of an efficient methods and innovative ideas are limit less. Currently, lot of energy is wasted in different forms and these can be utilized efficiently. For this project, we created a model with moving cars on a speed breaker that uses a bicycle pedal mechanism to provide modest quantities of electricity for specific applications. The system designed and implemented provides affordable solution for energy crisis affected to the common people. As a developing country, India's energy management is a crucial challenge. The proposed model has the ability to drive vehicle loads, and by installing numerous units of this kind in our nation's densely inhabited places, we can significantly reduce our energy consumption.

Keywords: Electricity generation, Bicycle Pedal mechanism, Road hump, Speed breaker

1 Introduction

Discovery of electricity is considered as one of the major revolutions in the history of science and technology. In this modern era, electricity plays a vital role and is crucial for domestic and commercial purposes. At present, human life is made easy with electricity and cannot imagine a day without its application. With the increase in human population, use of electric power has also increased. Also, the need for electricity is rapidly growing due to the enhancement in technology [1]. Energy crisis is a major concern now due to the shortage of resources available for generating electricity. Hence, there is an immediate requirement to generate electricity efficiently from the resources available in day-to-day life.

To overcome the electricity crisis, we need to develop a cost-effective system with optimal utilization of conventional resources available to us for the conservation of energy. Over the years different mechanisms have been implemented [2-13] with speed breaker mechanism to generate electric power (Table 1). In order to generate electricity, road hump electricity generating system is embedded in the road near tollgates, city malls or high traffic regions in metro cities. In this proposed model, when vehicle passes on the surface of this device, due to the pressure on the hump the device will dip down.

2

This downward movement causes dynamo's shaft to rotate and this leads to generate electrical energy. The generated electricity can be used for small scale applications.

Table 1. Comparison of different mechanism using speed breaker to generate electricity [2].

Parameters	Roller Mechanism	Air-Piston Mechanism	Bicycle Pedal Mechanism
Cost	Inexpensive	Costly	Moderate
Mechanism setup	Very easy	Very difficult	Difficult
Maintenance	Less is needed	Daily basis	Weekly basis
Efficiency	~50%	~80%	~70%
Design	Easy to design	Depends upon compressing power of air piston	Depends upon weight sustaining capacity

The proposed system aims to generate electricity through bicycle pedal mechanism. This proposed system is easy to install, economically beneficial, pollution free and provides a solution for solving the electrical energy crisis to some extent.

2 Materials and Methods

The electro-mechanical unit of the implemented systems consist of three major parts, which includes i) a damper system, ii) motion conversion system and iii) energy conversion system. The damper system provides support to the speed breakers. Recycled plastic, vulcanized rubber etc. constitutes speed breaker. Upward and downward movement of speed breaker is controlled by a spring. It is critical to absorb the shocks generated as vehicles travel over speed breakers.

Using a bicycle pedal, the damper system's vertical reciprocating action is transformed into rotating motion of the shafts. Block diagram of the implemented system is illustrated in **Fig. 1**. The hardware parts used to design and implement the proposed model are bicycle pedal arrangement, freewheel, dynamo, shaft, spring, chain drives, flywheel, bearing, gear wheel, sprocket and spur gear.

Prior to designing the prototype of the proposed model, the 3D structural representation of the model (**Fig. 2**) is designed by CAD software (solidwork). The implemented design uses square shape structure for the support. With the use of welding, these supporting structures made of mild steel with correct dimensions are attached to form a unit. Bearings of standard size are placed with their respective shaft and are welded to the frame structure. We have used four bearings to support two shafts. One shaft is of length 330 mm another of 339 mm. Larger shaft is in connection with the dynamo and smaller shaft is connected to the cycle pedal arrangement. All other components like sprocket, freewheel and gears are firmly fixed on the shafts. Smaller shaft which is

supported on two bearing, acts as intermediate between pedal arrangement and the larger shaft.

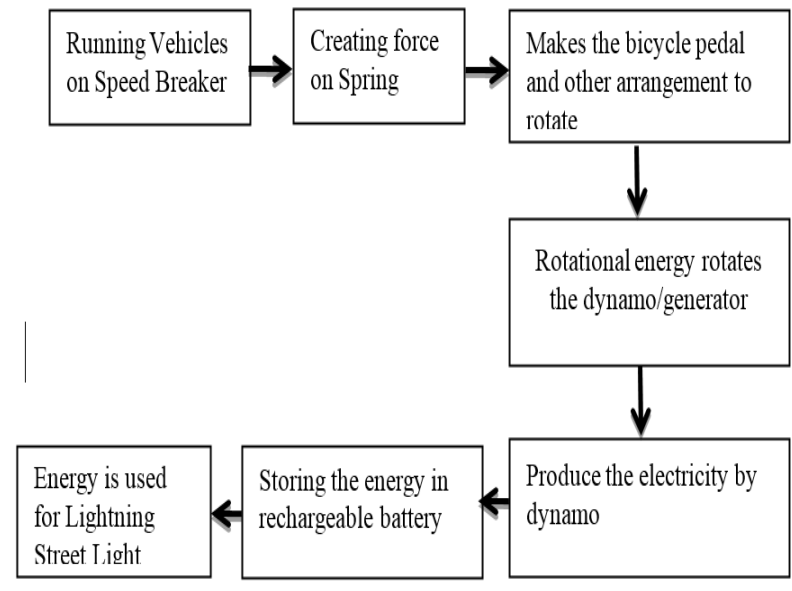


Fig. 1. Block Diagram of Proposed System

Bicycle sprocket is connected to freewheel through a chain drive and other sprocket on smaller shaft is connected to freewheel of larger shaft through another chain drive. Larger shaft is the one which drives the dynamo using gear arrangement. For the continuous rotation of the dynamo, flywheel of diameter 250 mm, is fixed on the larger shaft. The flywheel we used is of rubber material. This entire arrangement can be rotated by arranging the speed breaker. In our model we made a speed breaker by bending the metal sheet and is kept on the top of the system. Speed breaker is of height 165 mm and width 240 mm. To maintain the shape of the speed breaker, a small rod material is welded horizontally and vertically. This is mounted on the top of the system with the help of springs, which allows the movement of speed breaker in the vertical direction. The springs are fixed in such way that a hollow pipe of length 165 mm is welded, and spring is inserted on it.

4



Fig. 2. Three-dimensional view of the frame designed

3 Results and Discussion

The developed system is square in shape and constructed of mild steel. The structure is 660 mm in length, 610 mm in width, and 605 mm in height. Metal rods with a 1 cm thickness make up the single-hump system. Welding is used to link the anglers together. The hump is 20 cm in height and 28 cm in width. The bicycle peddle is connected to the hump. The mechanical spring causes the hump's up and down motion as shown in the **Fig.3**. The bicycle pedal in connected below the speed breaker and other hardware parts are attached to the model by means of bearings and shafts. The total weight of the structure is 47.8 kg and system can withstand a load up to 80 kg.

The energy generated from the speed breaker can be used for any kind of load by using necessary circuitry. In this system, we have developed a model to generate small amounts of power for localized applications.

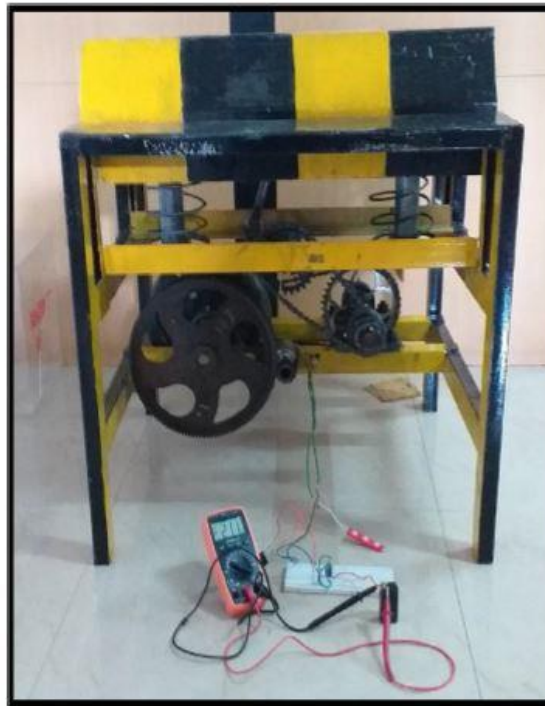


Fig.3 Prototype of Designed System

3.1 Output Power Calculations

$$\text{Work Done} = \text{Force} \times \text{Distance} \quad (1)$$

$$\text{Force} = \text{Mass} \times \text{Gravitational acceleration} \quad (2)$$

$$= 10\text{kg} \times 9.81$$

$$= 98.1\text{N}$$

$$\text{Distance Travelled} = \text{Height of the speed breaker}$$

$$= 16.5\text{cm} \Rightarrow 0.165\text{m}$$

$$\text{Output Power} = \text{Work done} / \text{sec} \quad (3)$$

$$= (98.1 \times 0.165) / 60 = 0.269 \text{ watts}$$

$$\text{Power Resulted by the vehicle} = 0.269 \text{ watts}$$

passing through the speed breaker
installation for one minute

$$\text{For 60 minutes} = 0.269 \times 60 = 16.14 \text{ watts}$$

$$\text{For 24 hours} = 16.14 \times 24 = 387.36 \text{ watts}$$

*Assumed Mass of the vehicle = 10 kg

6

As electricity crisis is increasing rapidly day by day, it is necessary to design a non-conventional power producing unit which can provide a solution to electrical energy crisis. This unit uses the wasted kinetic energy of the vehicle generated due to the friction between the tyre of the vehicle and road. Thus, providing an alternative power generation method thereby providing solution to energy crisis.

4 Conclusion

Non-conventional energy sources have played an important role in the power generation sector. We have created a model for this project that can provide modest amounts of power for localized applications. The system designed provides affordable solution for energy crisis to the common people. India being a developing country, energy management is prime concern for most of us, by using this designed system one can drive vehicle's loads for generating electricity. We can save a significant quantity of energy if several such units are installed in densely inhabited parts of our nation.

The proposed model highlights a new effective approach to generate electricity without using any natural resources. Utilization and appropriate storage of energy has an impact on growth of the nation and technological advancement. Shortage of electrical energy inversely affect the growth and development of developing countries. As a result, electricity generation using bicycle pedal mechanism is a fantastic novel solution since it may generate a lot of electrical energy from numerous speed breaker put on the highways. The energy generated can be easily used for minor needs like lighting roads lights and recharging electrical vehicles in near future. In this approach electricity generation is highly depends on the number of vehicles passing over the speed breaker. The usage of vehicles increasing every year. Hence, this kind of electricity generation is very economically beneficial and to meet the increased electricity demand. Similar to that, all of our nation's congested roadways can use streamlined road hump devices.

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