

Power Generation using Speed Breaker through Rack & Pinion Mechanism

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Abstract: Energy is the prime necessity of survival of each and every organism in the universe. In this busy and fast-moving world, population is multiplying continuously, and the conventional sources of energy are getting exhausted at a great pace. The substantial usage of energy has led to an energy crisis over a few years. In order to overcome this problem, we need to execute the techniques of optimum use of conventional sources for conservation of energy. One such technique is explained here. We can capture this kinetic energy at the speed breaker so that it can serve our purpose of electricity generation. An electromechanical unit is fixed under the speed breaker which is explained in the paper. Generating electricity by speed breakers is an ingenious and useful concept as it has more advantages as compared to its faults and it is best suited for the current situations.

Keywords: Speed breaker, Power generation, Rack and pinion, Electricity, Energy, Electromechanical unit, non-conventional sources, Kinetic energy, Mechanical energy, Vehicles.

I. INTRODUCTION

Energy can be converted into several forms that can be measured in various ways. Energy is important considering all sectors of a country's economy. Energy crisis is mainly due to two reasons first the population of the world has increased rapidly and second the standard of living of human beings has increased. The share of global electricity demand of developing countries jumps from 27% in 2000 to 43% in 2030. According to the International Energy Agency, the world will need almost 60% more energy in 2030 than in 2002. On looking to these situations one such method of power generation is explained in this paper. The count of vehicles passing over speed breakers on roads has increased these days. Such speed breakers are designed for heavy vehicles, as it increases the input torque and ultimately results in increasing the power as output. The kinetic energy of the moving vehicles at the

speed breaker can be converted into mechanical energy of the shaft by using rack and pinion mechanism. Then, this mechanical energy can be transformed to electrical energy using generator or dynamo which can be stored with the use of a battery. Therefore, by using this arrangement a large amount of energy can be conserved which can be used to fulfill our future demands. This energy saved during the daytime can be used at night to light the streetlamps. Further elaboration of paper is done below.

Problem Statement:

In our country due to increased paying capacity, advanced lifestyle and rapidly growing industrialization, the need & demand of transportation is increasing day-by-day. The number of vehicles passing on the track is increasing daily. Hence, we the group of our class found the need of designing and manufacturing such a system, which will make the track somewhat flexible, soft which will not damage the vehicle more also the impact energy being absorbed by the generation system will be utilized to convert it in to electricity rather than this hard impact transferring to damage the suspension.

II. LITERATURE REVIEW

1. SPEED BREAKER POWER GENERATION:

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 are 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.[7]

2. ELECTRICITY GENERATION BY SPEED BREAKER:

Energy is the primary need for survival of all organisms in the universe. Everything what happens in the surrounding is the expression of flow of energy in one of the forms. But in this fast-moving world, population is increasing day by day and the conventional energy sources are lessening. The extensive usage of energy has resulted in an energy crisis over the few years. Therefore, to overcome this problem we need to implement the techniques of optimal utilization of conventional sources for 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 vehicle passes over it. We can tap the energy generated and produce power by using the speed breaker as power generating unit. The kinetic energy of the moving vehicles can be converted into mechanical energy of the shaft through rack and pinion mechanism. Then, this mechanical energy will be converted to which will be saved with the use of a battery.[6]

3. Electrical Power Generation Through Speed Breaker:

This project is to enlighten the streets utilizing the jerking pressure which is wasted during the vehicles pass over speed breaker on the roadside. The system can tap the energy generated by moving vehicles and produce power by using the speed breaker as a power generating unit. The kinetic energy of the moving vehicles can be converted into mechanical energy through a rack and pinion mechanism and this mechanical energy will be converted to electrical energy using a generator which will be used for lighting the streetlights. Therefore, by using this mechanism we can save a lot of energy which can fulfill our future demands.

III. METHODOLOGY

- 1) Practical Approach – It was seen that whether modeling the selected mechanism is practically possible or not.
- 2) Cost of the total project – The total cost of the project must be limited.
- 3) Feasibility - The construction of the project must be easy and can be done at a student level. Additionally, availability of certain components or processes is seen.

- 4) Efficiency – The efficiency obtained from the mechanism must be high.

1. METHOD SELECTED – RACK AND PINION MECHANISM:

Electricity is a basic part of nature and it is one of our most widely used forms of energy. A large amount of energy is wasted at the speed breakers through the dissipation of heat and through friction, every time a vehicle passes over it. In this research, a roller is fitted in between a speed breaker and some kind of a grip is provided on the speed breaker so that when a vehicle passes over speed breaker it gets displaced in vertically downward direction distance 7 cm. The rack which is connected to the speed breaker also moves down simultaneously with same distance 7 cm. The rack is in mesh with the pinion which is coupled with the shaft of gear which have 72 teeth which then meshed with pinion with 32 teeth which is coupled with the generator motor. This whole mechanism converts linear displacement in rotary motion. Hence shaft of generator rotates which generates current proportional to the number of revolutions of pinion. This produced current is stored in battery for future use. Later the rack gets displaced to the original position due to spring mechanism.

Description:

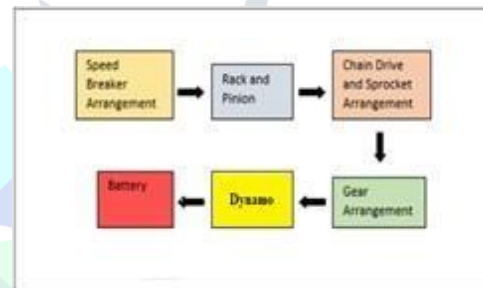


Fig. Block diagram of experimental setup

IV. DESIGN WORK

The main objective of design phase is to make use of waste materials for manufacturing of the modified speed breaker. During brainstorming we decided what could be better than if we could use scrap car parts and did the same. Everyday hundreds of cars get dumped into junkyard due to some tragic events. Most of the major components of our project are derived from used cars. The most important component i.e. the “Rack and Pinion” mechanism was extracted from steering mechanism of a car. Also, the springs which return the speed breaker to its original position were obtained from suspension of a car. This

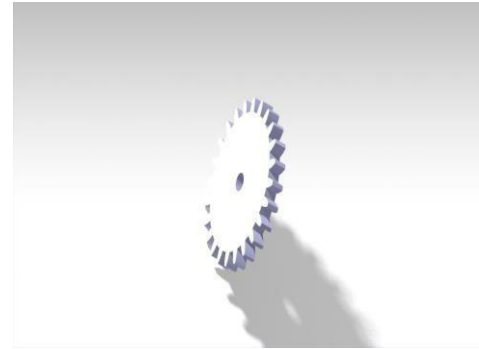
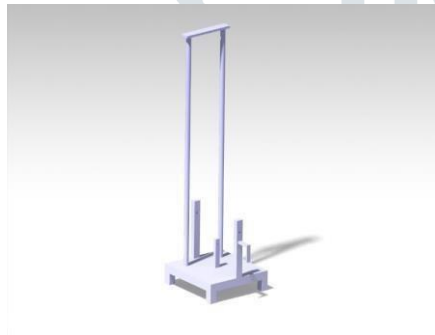
serves dual purpose, firstly it uses waste material from cars and another, that it is suitable to handle the weights of similar class vehicles passing over the speed breaker. Also, we needed to simplify the design in such a way that we could manufacture it using the techniques available to us at our level. We decided to use a bottom up approach for our design. For example, starting from the base plate, we used welding techniques to make supporting pipe structures on it. Then we could support the two springs which will be used to bring back the speed breaker into its original position into those pipes. In this way we could

S

pur Gear:

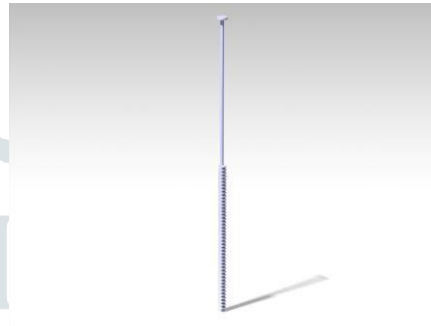
accomplish the changes or modifications necessary to design during manufacturing phase. For designing CAD model of our project, we have chosen to use solid works because of its ease to use and seamless, integrated workflow design. First, we created all the main components one by one in solid works and then assembled them to make complete design

VARIOUS COMPONENTS OF THE SYSTEM



Part 3. Gear

Material: C. I (Cast Iron) Quantity: 2



R
a
c
k

1. Frame

&
P
i
n
i
o
n
:

Material: C. I. (Cast Iron)
Size: 500 x 50 (L x w)
Operations: Cutting,
Welding
Tools: Cutting Machine & Arc
Welding Machine
Quantity: Rack: 1
Pinion: 1

Part 1 Frame

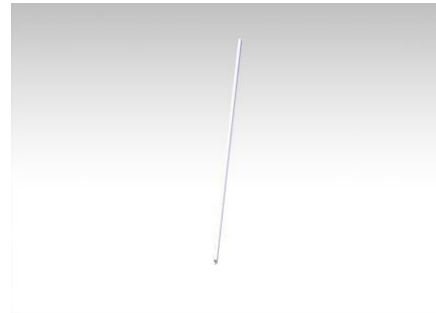
Material: M. S Square Pipe Size:
25 x 25 mm

1.5 mm Thick Dimensions: 300 x

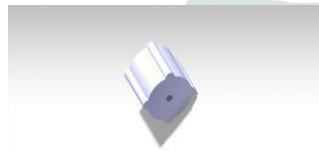
400 x 600 mm Operations: Cutting,

Welding

Tools: Cutting Machine & Arc Welding
Machine



Shaft



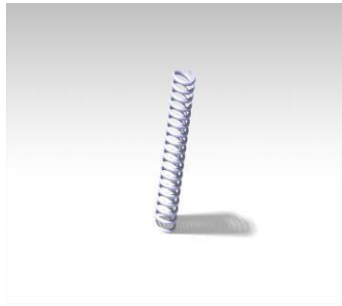
Part 2 Dynamo

Operations: Cutting,
Grinding, Welding Tools:
Cutting Machine,
Grinding Machine & Arc
Welding
Quantity: 2

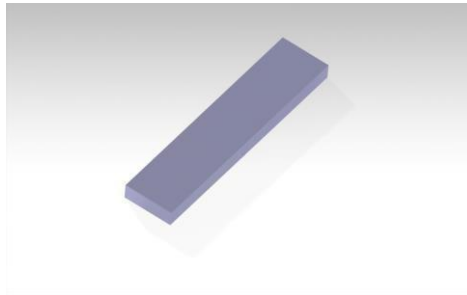
Part 5. Shaft

Material: M.
S. Rod Size:
Diameter: 15
mm Length:
400 mm





Part 6. Spring



Part 7. Track

Flat Plate:

Material: M. S. Sheet
 Size: 150 x 500 mm (w x L)
 Operation: Cutting, Bending
 Tools: Cutting Machine & Bending Machine
 Quantity: 1

V. ACTUAL MODEL



Figure 1 Top View of Model

Calculations

Let's consider,

The mass of vehicle moving over the speed breaker = 50Kg (Approximately)

Height of speed breaker = 10 cm

Weight of the Body = 50 Kg × 9.81 = 490.5N

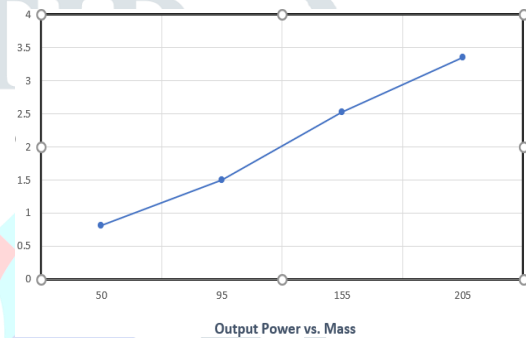
Distance travelled = Height of the speed breaker = 10cm

Work done = weight of the body × distance travelled by the pressure of vehicle

Power = Work done/Second = (490.5×0.10)/60 = 0.8175 Watts

Similarly,

For vehicle of masses 95, 155, 205 the power developed will be 1.5, 2.53, 3.35 watts respectively.



VI. FUTURE SCOPE

- 1) Heavy vehicles can generate high torque using larger pinion and powerful generator and hence the power generated from them will be quite high.
- 2) More suitable and compact mechanisms to enhance efficiency could be created.
- 3) As these systems are installed on open roads, water accumulates in heavy rainfall regions which may be a threat for working of this system. So, waterproof system can be developed to use this system in heavy rainfall regions also.
- 4) Multiple generators could be connected so that power generated would be more.

VII. ACKNOWLEDGEMENT

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VIII. 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 research is to introduce another innovative method of green power generation in order to contribute toward developing the world by enriching it with utilization of available resources in more useful manner.

This arrangement, with some modification can also be used in different application like in footsteps in schools, colleges and residential apartments, so that the power production rate is increased and demand at a particular area can be fulfilled.

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