

POWER GENERATION THROUGH SPEED BREAKER

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ABSTRACT

The project is about the design and manufacturing of speed breaker power generator. In this project we are trying to utilize one such source. Electricity is generated by replacing the traditional speed breakers with some simple mechanism. As vehicles pass over the speed breakers, the speed breaker itself goes down due to weight of the vehicle which results in displacement of a rack gear which rotates the pinion connected to shaft of the generator which in turn produces electricity.

This method is an effective way to produce electricity as the numbers of vehicles on the road are ever increasing. Also, the cost of fabrication of the model is low. It can be effectively placed near traffic lights, at the entrance of parking lots and any other place where the traffic density is high. As vehicle passes over it, it starts moving. This method provides an efficient way to generate electricity from the kinetic energy of moving vehicles in roads, highways, parking lots etc.

In this report we explain in detail the various stages of research, design and manufacturing which was involved in

the construction of various components such as springs, generator, rack and pinion mechanism. Most of the parts are assembled by the students themselves. It also mentions the reason behind using the specific materials and methods of construction for effective working of the system. In short, this report includes an overview of design and research undertaken in making the project successful.

The mantra of the group “In engineering, everything has a reason” is highlighted in the following report.

Keywords: Non - Conventional energy source, generator, rack and pinion mechanism, speed breaker power, shaft, guiding pipe

INTRODUCTION

Now a day's power has become the major need for human life. Energy is an important input in all the sectors of any countries economy. The availability of regular conventional fossil fuels will be the main sources for power generation, but there is a fear that they will get exhausted eventually by the next few decades. Therefore, we have to investigate other types of renewable sources

The day-to-day increasing population and decreasing conventional sources for power generation, provides a need to think on non-

conventional energy resources [1] [2]. Another major problem, which is becoming the exiting topic for today is the pollution. Power stations and automobiles are the major pollution producing places. So non-conventional power source is needed to reduce this problem. We proposed a non-conventional power generating system based on speed breaker mechanism which generate electricity without using any commercial fossil fuels, which is not producing any polluting products [3]. In this paper, our aim is to conserve the kinetic energy which convert into electricity that gone wasted, while vehicles moveing.

1.2 MOTIVATION

An energy crisis is any significant bottleneck in the supply of energy resources to an economy. Industrial development and population growth have led to a surge in the global demand for energy in recent years. There is a current global need for clean and renewable energy sources. Fossil fuels are non-renewable and require finite resources, which are dwindling because of high cost and environmentally damaging retrieval techniques. So, the need for cheap and obtainable resources is greatly needed

1.3 MODIFICATION

This project attempts to show how energy can be tapped and used at a

commonly used system, the road speed breakers. The number of vehicles passing over the speed breaker in roads is increasing day by day. A large amount of energy is wasted at the speed breakers through the dissipation of heat and also through friction, every time a vehicle passes over it. There is great possibility of tapping this energy and generating power by making the speed-breaker as a power generation unit. The generated power can be used for the lamps, near the speed breaker. The present work an attempt has been made to fabricate a bump, which can utilize the kinetic energy of vehicles in power generation. This type of bump is best suited for the places where the speed breaker is a necessity. The places like Toll bridges or on vehicle parking stands are best for its utilization. The work also discusses the shortcomings of existing methods and the ways it is countered by this method

2. LITERATURE REVIEW

2.1 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 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. [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 passes 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 electrical energy using generator which will be saved with the use of a battery. [3]

3 METHODOLOGY

METHODOLOGY

Power can be produced from conventional and nonconventional energy sources. In this paper we show energy conversion from kinetic energy to rotational energy and rotational energy to electrical energy respectively [4]. This project explains

the mechanism of electricity generation from speed breakers.

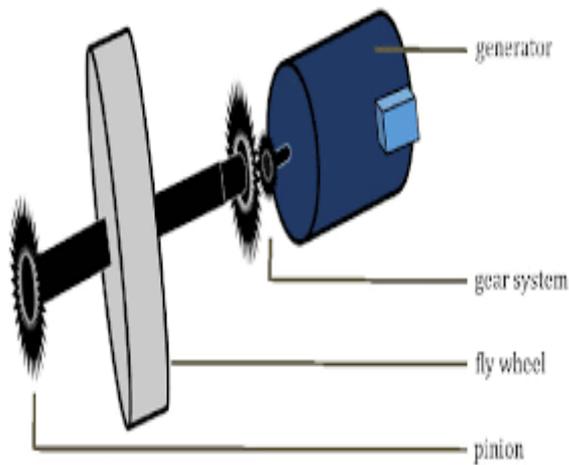
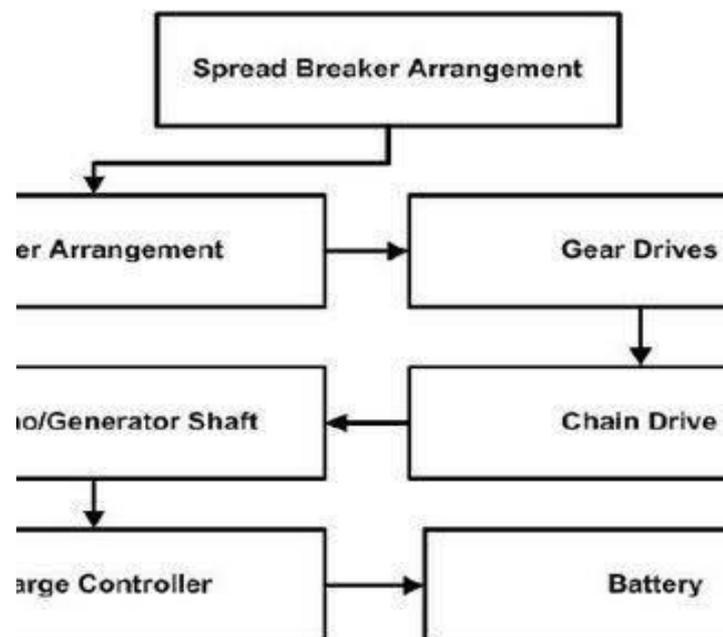


Fig. 3. Fly wheel and generator mechanism

It is a simple but optimum

process to generate energy from speed breaker arrangements. There are a large number of vehicles running on

system utilizes both mechanical technologies and electrical techniques for the power generation and its storage. The generation will be proportional to the traffic density [5].



4. SYSTEM DESIGN & FUNCTION

In this research, vehicle pressure on the speed breaker which is converted into rotary energy through rack and pinion using hydraulic press. Consequently, this rotary energy rotates generator that generates electrical power which is being stored through battery using charging circuit [6]. The whole Syst

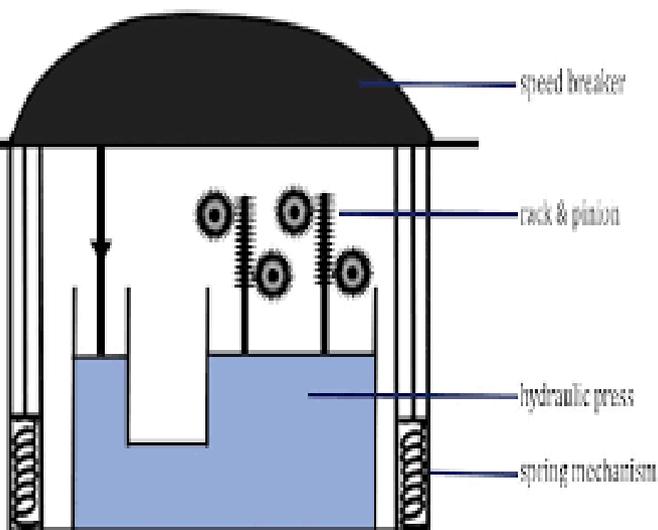


Fig. 4. Speed breaker mechanism

the road. These vehicles are going over a number of speed breakers present on the road. We want to replace this traditional speed breakers with our proposed speed breaker. It is an Electro-Mechanical unit. This

When the vehicle load acted upon the speed breaker system is transmitted to rack and pinion arrangements. Because of the weight of vehicle the top portion of the speed breaker moves downwards [7]. The pressure rod which one side is attached to the bottom of the speed breaker and other side to small piston of hydraulic press. The hydraulic press convert the force into 4times from small piston to large piston. 3 rakes attached to large piston.

Every rack connected with 2 one way pinion. Pinions are getting rotation from the movement of rack backward and forward. Every pinion connect to a fly wheel which absorbs the energy when demand is less and releases the same when it is required. Fly wheel connected to a large gear and large gear connected to a small gear which attached to a generator. Generator convert rotational energy into electrical energy [8]. When the vehicle passes the speed breaker, the expansion of springs takes the speed breaker at previous state which done the system reverse.

The charging circuit charges a battery. The Inverter circuit converts this DC voltage into AC voltage and a step up transformer stepped up the AC voltage. A dark sensing circuit is used to sense the night so that the street light lit on.

5. Different mechanism

1. Roller mechanism
2. Rack and Pinion
3. SPRING Coil Mechanism
4. Crank-shaft Mechanism

5.1 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 also 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

6.SYSTEM CONSTRUCTION

Speed breaker, spring arrangement, hydraulic press, rack and pinion combination, freewheeling and gear combination, generator, charging circuit, battery, dark sensing & switching circuit, inverter circuit and step up transformer used to the

6.1 SPEED BREAKER

It's the top portion of the system which is made of iron in curved shape. The main function of this speed breaker is to sustain the pressure through it.

6.2 SPRING ARRANGEMENT

A spring is an elastic body whose function is to distort when loaded and to recover its original shape when the load is removed. It cushions, absorbs or controls energy either due to shocks or due to vibrations [9]. There are four helical springs below the speed breaker which are squeezed when vehicle pressurizes upon it and it bring the speed breaker at previous state.

6.3 HYDRAULIC PRESS

Fig. 3. Fly wheel and generator mechanism
In a hydraulic press a small force applied on a column of liquid is converted into a much greater force available to another column of liquid. It is an application of Pascale law. In our proposed system it convert the force into 4times from small piston to large piston when the pressure created on speed breaker using this equation,

$$F_2 = F_1 \times \frac{A}{a}$$

F_1 = created force on small piston by speed breaker

F_2 = converted force by hydraulic press

a = area of small piston

A = area of large piston

6.4 RACK AND PINION

Rack and pinion can convert rotary to linear or from linear to rotary motion [10]. Rack is a linear gear and pinion is a circular gear. Applied force on rack is converted to rotation by pinion. The mechanical force is converted into rotational force.

6.5 FLY WHEEL

The primary function of flywheel is to act as an energy accumulator. It reduces the fluctuations in speed [11]. It absorbs the energy when demand is less and releases the same when it is required.

6.6 GENERATOR

The device which converts mechanical energy into electrical energy is called generator. An AC generator is used for producing alternating current which contains an assembly of stationary (stator) and moving parts (rotor). The rotor is connected with the gear. The torque which generated by gear rotary of the generator. The rotor creates a moving magnetic field around the stator, which induces a voltage difference between windings of stator and produce the alternating current (AC) output of the generator [12]

6.7 CHARGING CIRCUIT

Charging circuit is used to charge the battery show the charging circuit.

6.8 DARK SENSING AND SWITCHING CIRCUIT

Dark sensing circuit sense the dark and switch the light on shows the dark sensing & switching circuit.

6.9 INVERTER CIRCUIT & SET-UP TRANSFORMER

Inverter convert DC voltage to AC voltage and step up transformer is a type of transformer which stepped up the AC voltage. In this system inverter circuit converts 12V DC to 15V AC. Step up Transformer makes the voltage to 250 V AC from 15 V AC.

7. POWER CALCULATION & RESULT ANALYSIS CALCULATIONS

7.1 REDUCTION RATIO

1) 3cm rack displacement gives 1 pinion rotation. Hence the larger gear coupled with the pinion shaft rotates $\frac{7}{3} = 2.33$ rotations (Total displacement of rack = 7cm).

2) No of Teeth on larger gear = 72,
 No of teeth on smaller gear = 32.
 Hence 1 rotation of larger gear is $\frac{72}{32} = 2.25$ rotations of smaller gear.

3) 2.33 rotations of larger gear give $2.33 * 2.25 = 5.25$ rotations of smaller gear (generator gear).

4) Therefore, 7cm displacement of rack gives 5.25 rotation of generator shaft.

7.2 CALCULATIONS FOR DESIGNING

Spring design for 200 kg weight: -

Weight of vehicle = $200\text{Kg} * 9.81 = 1962.00\text{ N}$

Therefore $P = 1.962\text{ KN} = 2\text{KN}$

Permissible shear stress is taken as 0.5 of S_{ut}

$\tau = 0.5 * S_{ut}$ (ultimate tensile strength)

$\tau = 0.5 * 1050 = 525\text{ N/mm}^2$

The spring stiffness k,

$K = (4c - 1/4c - 4) + (0.615/c)$ std formula

$K = (4 * 8 - 1/4 * 8 - 4) + (0.615/8)$

$K = 1.184$

Calculation of wire diameter d,

$\tau = k * (8pc / \pi d^2)$

$525 = 1.184(8 * 2000 * 8 / \pi * d^2)$

$D=11\text{mm}$

Free length of spring =230mm

7.3 OBTAINED RESULT

Voltage (D.C) =1.5V

Current (D.C) =3.55 milliampere

8.1 ADVANTAGES

Using this proposed technology we can get the following advantages:

- Nonpolluting power generating source
- Power generation with low cost.
- Simple construction, mature technology.
- LESS floor area required and no obstruction to traffic.
- No need of manual work during power generation.
- Low installation and maintenance cost
- Power generation using non-conventional energy sources.
- Easy for maintenance and no fuel transportation problem.
- Simple construction, mature technology, and easy maintenance.

8.2 DISADVANTAGES

- Selection suitable Generator
- Selection of SPRING

ACHIVEING proper balance of speed and torque

It Gives Low Electric Output

9 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. Any country, especially Nigeria and other developing nations, can only develop when there is steady and available power supply for its citizens and not by getting breakdown in middle course of time or unreliable power sources. Now time has come for using these types of Innovative ideas and it should be brought into practice. It is suggested that further developments should be done to minimize above mentioned challenges. This research can also be modified by using camshaft and pulley stem or concepts of fluid mechanics can be used instead of gears, so as to minimize the inherent complexities and difficulties. By using the concept of power generation new ideas

should be introduced which would help in reduction of friction and increase the efficiency of the generators

10. FUTURE SCOPE

- Suitable at parking of multiple, malls, toll booths, signals
- Uses: Charging batteries and using them to light up the
- More suitable and compact mechanisms to enhance efficiency
- Such speed breakers can be desired for heavy vehicle, thus increasing torque and ultimately output of generator

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NOMENCLATURE

- OTEC- Ocean thermal energy conversion
- CFL- Compact florescent lamp
- AC- Alternating current
- DC- Direct current