

DESIGN AND IMPLEMENTATION OF POWER GENERATION MECHANISM USING SPEED BREAKER

Roman Kalvin, Anam Nadeem, Saba Arif

Abstract— In the current scenario demand of power is increasing day by day with increasing population. It is needed to sort out this problem with a technique which will not only overcome this energy crisis but also should be environment friendly. This research emphasizes on idea which shows that power could be generated by specially designed speed breaker. This project shows clearly how power can be generated by using Cam Mechanism where basically linear motion is converted into rotatory motion that can be used to generate electricity. When vehicle passes over the speed breaker, presses the cam with the help of connecting rod which rotate main shaft attached with large pulley. A flywheel is coupled with the shaft whose purpose is to normalize the oscillation in the energy and to make the energy unvarying. So, the shafts will spin with firm rpm. These shafts are coupled from end to end with a belt drive. The results show that power generated from this mechanism is 12 watts. The generated electricity does not required any fuel consumption it only generates power which can be used for the street light as well as for the traffic signals.

Keywords—Revolution per Minute (RPM); Cam; Speed Breaker

1 INTRODUCTION

Now Pakistan is suffering from energy crisis in all most every field. So that's why Pakistan grossed domestic product is low because due to industrial shut down, shut down of local factories as well domestic factories. The day-to-day increasing population and decreasing conventional sources for power generation, provides a need to think on non-conventional energy resources [1]. The alternatives sources are solar energy, wind energy, geothermal, hydroelectric and nuclear. In this paper it is mainly focused on the principle of Potential Energy to Electrical Energy Conventional. Potential energy can be thought of as energy stored within a physical system. This energy can be released or converted into other forms of energy; including kinetic energy. There are five mechanisms to generate electricity through speed breakers viz., Rack & Pinion mechanism, Crank Shaft mechanism, Roller mechanism, Spring Coal mechanism and Cam mechanism [2].

This paper focus on Cam mechanism. It is cost effective and environmental friendly power generation system. The principle of this project has few steps in it regarding which generates power through speed breaker using mechanical system. By the proper arrangement of mechanical components and equipment, kinetic energy can be converted into electrical energy.

The idea of basic physics to convert the kinetic energy into electrical energy that gone wasted when the vehicle run over the speed breaker. Design of every part has been approved using standard measures, and the mechanism have been made-up and accumulate. A like sculpt of the arrangement has been formed using Solid Works. Practical testing of the system has been done with different loads. Upholding cost is low, fitting price is low and also resolve some of the power problems of the globe. The energy produced by this method can be used to impel an electric motor or for any other function. Their effort can be execute on road and can be used to lighten the street light and traffic signals.

This setup works on the principle of converting the kinetic energy of vehicles into rotary motion. This rotary motion is stored in flywheel which will be used in the generation of electrical power. The power generated is stored in dry battery. The amount of rotation depends upon weight of the car moving over the platform of the speed breaker.

Voltage which produced from mechanical system is A.C voltages while required are D.C voltages to store in the battery, so for this purpose rectifier circuit is used. In rectifier circuit, half wave rectifier or full wave rectifier can be used. Full wave rectifier is used because it gives full waves. So now A.C voltages are converted to D.C voltages. Now by placing next the battery charger circuit and battery, battery charger is

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circuit is the charging the battery and this D.C voltages are stored in the lead acid battery of 12 volts.

This technique have many recompense such as electricity generation does not need any stimulate input, operational cost is very less. This is a non- conventional type of energy and therefore very practical in the current situation of energy problems [3] shortcoming such as perfunctory moving parts are more in this arrangement therefore there are very high frictional losses and therefore need more repairs, preliminary cost of this array is very high. The overall efficiency is fairly low as compared to other practices.

2 FABRICATION

2.1 Block Diagram of the Design

Block Diagram of Power Generation Mechanism through speed breaker is shown in fig. 1 First of all project is designed on solid work software then fabricated according to design.

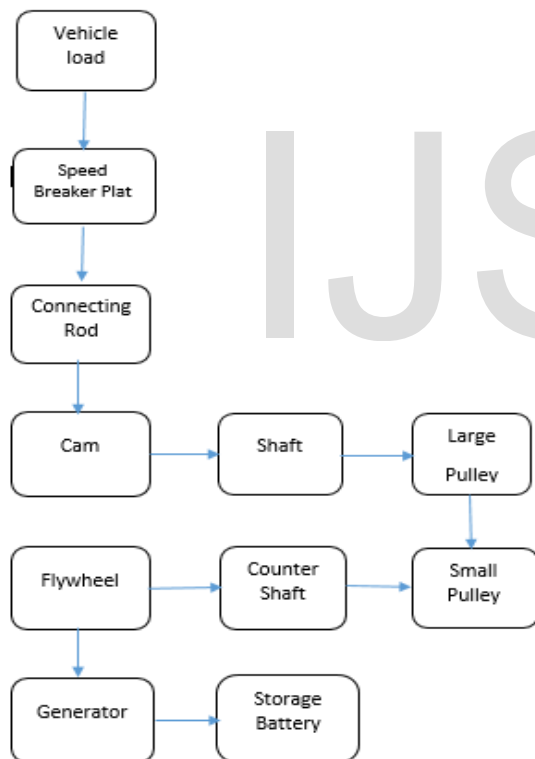


Figure 1: Block Diagram

2.2 Components used in the system

The following components are designed separately and are then assembled to get the power generation system Connecting Rod, Cam, Crank Shaft, Pulleys, Flywheel, Bearings and Generator.

2.3 Connecting Rod

A connecting rod is a rod that transfers motion between a render part of a machine (as a piston) and a rotating part (as a

crankshaft). Connecting rods are used in infinite situations, generally in the engines of automobiles. The main function of the connection rod is to transmit reciprocating motion of the speed breaker to the cam. Where one end of the Connecting rod is connected to the speed breaker plates whereas other end is connected with the cam. Connecting rod is used in engines to transmitted motion. Here connecting rod is used for the same purpose for the transmission of the motion. In this research, the connecting rods are used to transmit the force from slider to cam and cam rotates the shaft. These connecting rods are manufactured on CNC machine.

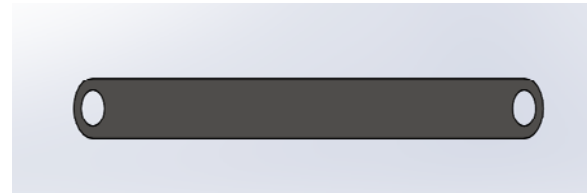


Figure 2: Connecting Rod

2.4 Cam

In a cam follower system, the movement of the follower is very significant. Its dislocation can be connive against the angular displacement θ of the cam and it is called as the displacement diagram. In this research required cam is symmetric cam for the transmitted of the motion, there is no follower used in project that's why not important the rise and dwell angle [4] Cam was fabricated on CNC machine, firstly make the drawing on software then write the program on control unit of CNC machine with the help of M-code and G-code after that executes the program and machine starts the operation and made the required cam as want.

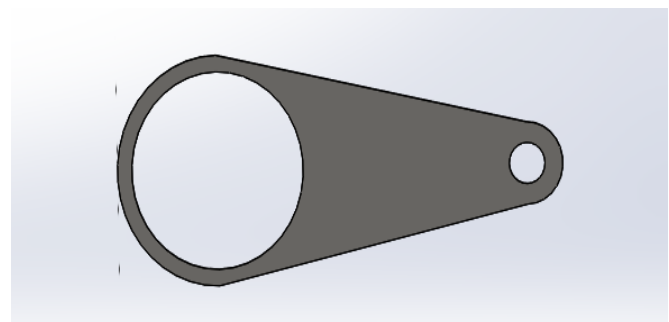


Figure 3: Cam

2.5 Crankshaft

A shaft is a rotating device normally of circular cross section (either solid or hollow) transmitting power. Supports which is provided by gears, sprockets, wheels, rotors etc. It is subjected to torsion and to transverse or axial loads, acting singly or in combination. The shaft always stepped with maximum diameter in the middle portion and minimum diameter at the two ends, where bearings are mounted. [5]

One important approach of designing a transmission shaft is to use ASME code. According this code, the permissible shear stress for shaft without keyways is taken as 30% of yield strength in tension or 18% of ultimate tensile strength of material.[6]

In this research shaft of 610 mm and 31.75 mm is used.

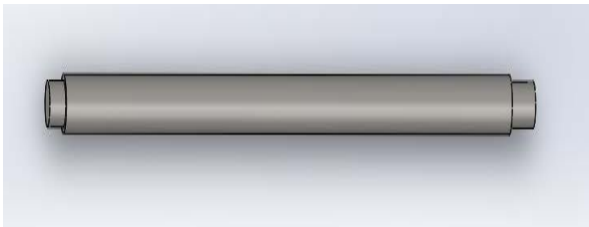


Figure 4: Shaft

2.6 Pulleys

Pulleys are the most ancient power transmission element, but the most important thing in pulley is its design. If the belt is kept around a fixed shaft, there will be friction between belt and the shaft. Only pulley can reduce that friction if it used. Pulley transmits power from one region to another region. Normally pulley is used to lift the heavy object. In pulley design is velocity ratio is the most important factor. For high power transmission V-belt pulley is used. In this project Pulleys of 16 and 2 inch are used of material cost iron. Velocity Ratio between the two pulleys is 8:1. It mean when the large pulley covers one revolution the small pulley will turn eight revolutions.

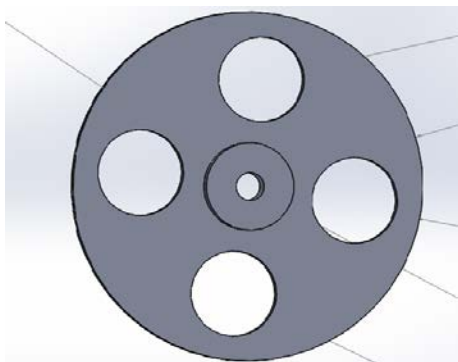


Figure 5: Pulley

2.7 Flywheel

The flywheel is generally attached at the end of shaft in order to have uniform torque throughout the cycle (rotation of shaft). Flywheel store energy at some time and give up, when required. A Flywheel Energy Storage system is an electromechanical storage system in which energy is stored in the kinetic energy of a rotating mass. [7] For designing a flywheel, first thing is to decide the diameter of flywheel. It is

sometime is limited by the space consideration and value of flywheel is selected accordingly. Diameter of flywheel is 431 mm. There are two types of flywheel solid and rim. In research solid flywheel is used with 30 kg and material of mild steel.



Figure 6: Flywheel

3 WORKING PRINCIPLE

This setup works on the principle of converting the kinetic energy of vehicles into rotary motion. This rotary motion is stored in flywheel which will be used in the generation of electrical power. The power generated is stored in dry battery. The amount of rotation depends upon weight of the car moving over the platform of the speed breaker.

As the vehicle passes over the speed breaker. Cam is pressed down 30° by connecting rod. It will rotate the main shaft, which give certain rpm to the large pulley. By the help of belt small pulley will rotate eight times. Which gives rotation to flywheel and energy will be stored. Greater the energy will store; more will be the power output.

Voltage which produced from mechanical system is A.C voltages while required are D.C voltages to store in the battery. So, for this purpose rectifier circuit is used. In rectifier circuit, half wave rectifier or full wave rectifier can be used. Full wave rectifier is used. So now A.C voltages are converted to D.C voltages. Now by placing next the battery charger circuit and battery, battery charger is circuit is the charging the battery and this D.C voltages are stored in the lead acid battery of 12 volts.



Figure 7: Assembled Model of Speed Breaker Power Generation System

4 RESULTS

The mass of 100 kg is applied number of time on the speed-breaker system and the produced amounts of voltage, current, Energy stored in flywheel and angular speed are measured.

4.1 RESULT RELATED TO POWER OUTPUT

Power is the rate of electrical energy per unit time. It is measured in watt.

$$\text{Power} = \frac{2\pi NT}{60} \text{ Watt}$$

The Power generated at different Load Condition and rpm is observed and readings are tabulated as below.

TABLE 1
Load and RPM vs. Power Output

Sr No.	Load (Kg)	No of Times	RPM	Power (watt)
1	100	7	120	12
2	100	8	160	20
3	100	9	265	30
4	100	10	416	40
5	100	25	941	90

If Vehicles pass on Speed Breaker after every 9 Second on Toll Plaza

1 Vehicle = 43 rpm

TABLE 2
RPM vs. Power Output

Sr No.	No of Vehicles	RPM	Power (Watt)
1	4	120	12
2	8	240	20
3	12	360	40
4	16	480	50
5	20	600	60

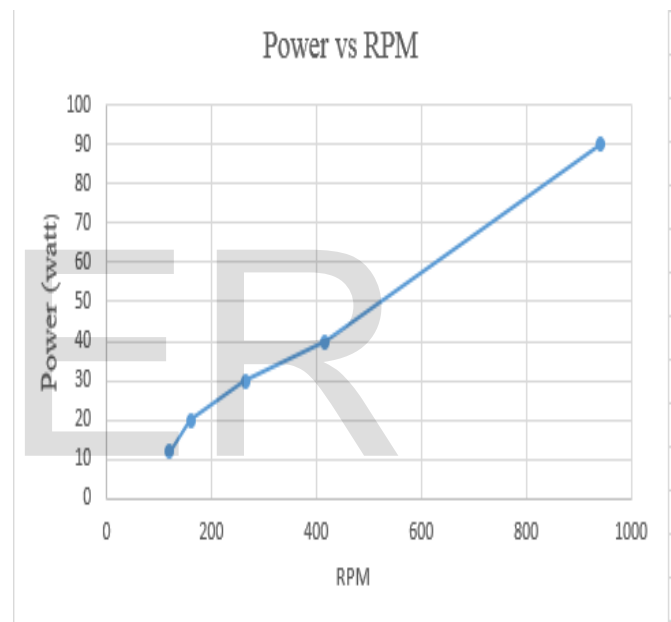


Figure 8: Power vs. RPM

Fig. 8 represent the as rpm increase the output power also increase. Speed of generator increase more electricity will produce.

4.2 RESULT RELATED TO ENERGY STORED IN FLYWHEEL

$$\text{Energy Store in Flywheel} = \frac{I \cdot \omega^2}{2}$$

$$\omega = \frac{2\pi N}{60}$$

ω = Angular Velocity

N= No of RPM

TABLE 3
RPM vs. Energy Stored

Sr No.	RPM	Energy Stored in Flywheel (J)
1	120	52.76
2	160	97.93
3	265	257.21
4	416	662.55
5	941	3244.7

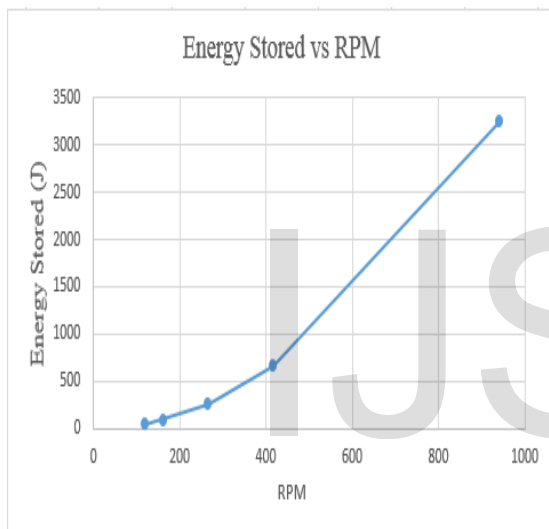


Figure 9: Energy Stored vs. RPM

Fig. 9 represent as the rpm increase more energy will be stored.

5 ADVANTAGES OF POWER GENERATION USING SPEED BREAKER

- Pollution free power generation.
- Low maintenance cost.
- No labour cost.
- No manual work necessary during generation.
- Energy available all the year.
- No consumption of any fossil fuel which is non-renewable source of energy.

6 CONCLUSIONS

This is a non-conventional source of producing the energy. The existing source of energy such as coal, oil etc. may not be sufficient to meet the increasing energy demands. These conventional sources of energy are also depleting and may be exhausted at the end of the century or beginning of the next century. The purpose of this project is to design and implementation of reliable environmental friendly renewable energy source using speed breaker as an energy harvester scheme to reduce the energy shortfalls. It is economical and easy to install. Low Maintenance cost having no labor. Speed breaker can be implemented on heavy traffic roads and toll booths and can be used to power the street lights.

- The powers of 90 to 120 W can be generated from the speed-breaker system when mass of 1600 kg is applied.

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