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Research Article

Generation of Energy using Rack-Pinion Mechanism and Dynamo

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A B S T R A C T

In this modern world, electricity is a big problem which is faced by people everywhere. Electricity is the form of energy, Electricity plays vital part in our life and it is one of our most widely used forms of energy. We get electricity, which is a secondary energy source, from the conversion of other sources of energy like oil, natural gas, coal, nuclear power and other natural sources, which are called primary sources. Before electricity generation began slightly over 100 years ago, we use kerosene lamps and wood-burning or coal burning is major source of energy. Direct Current (DC) electricity had been used in arc lights for outdoor lighting. In the late-1800s, Nikola Tesla initiate the generation, transmission and use of Alternating Current (AC) electricity, which can be transmitted over much greater distances than direct current. Generating electricity by speed breakers is innovative and useful concept. Researches show that the world has already had its enough Shares of its energy resources. Fossil fuels cause pollution. Nuclear energy requires careful handling of both raw as well as radioactive waste material. The focus now is shifting more and more towards the renewable sources of energy, which are non-polluting. Energy conservation is the cheapest new source of energy. The utilization of energy is an indication of the growth of a nation. One might conclude that to be materially rich and prosperous, a human being needs to consume more and more energy. This paper is best source of energy that we get in day to day life. This project is presenting the study of electricity generation through the speed breaker using rack-pinion and dynamo mechanism.

Keywords: Energy Generation, Speed breaker, Rack and Pinion, Dynamo, Electricity, Electro-mechanical Energy, Nonconventional Sources, Inverter, Mechanical Energy, Vehicles, Electrical Loads

Introduction

As identified by Aswathaman[1] three different mechanisms are currently being used in power generation via speed breakers. These are: Roller type mechanism the Rack- Pinion mechanism Crank-shaft mechanism.

Singh et al. Discussed[1] rack-pinion and dynamo mechanism to generate electricity. They proposed mechanism using chain sprocket and gears with rack pinion to generate electricity.

Vehicle was passed over that speed breaker and then due to rack pinion there was rotation in rod and shafts moved with chain sprocket movement. Dc power was generated using dynamo and was stored in a battery and then using an inverter they changed that dc in ac power. Das et al.

proposed mechanism in which electricity was produced by mechanical energy of speed breaker.

The basic principle was when a car passes over the hump ordome which is the device use in place of jump the dome will go down due to weight of car while moving car possess kinetic energy that kinetic energy will be converted into rotational energy with the help of rack and pinion. A fly wheel was mounted on theshaft whose function was to make energy uniformly. That shaft is connected through a belt withdynamos.These dynamos were used to convert mechanical energy in electrical energy. The power was generated in both directions. They used Zener diode to generate power in opposite direction too.

In the present scenario power has becomes major need for human life. Due to day-to-day increase in population and lack of the conventional sources, it becomes necessary that we must depend on non-conventional sources for power generation.

While moving, the vehicles posses some kinetic energy and it is being wasted. This kinetic energy can be utilized to produce power by using a special arrangement called “Power Hump”. In this project we show that how we can generate a voltage from the busy traffic using speed breaker. Conversion of the mechanical energy into electrical energy is widely used concept. Mechanism to generate power by converting the reciprocating energy generated by a vehicle going up on a speed breaker into rotational energy.

We have used that simple concept to the project. We connect one mechanical rod with the dynamo and fit this rod on the surface of the road. When any vehicle moves from this roller then due to friction. When dynamo move then it generates a voltage and this voltage now connects to the bulbs. In actual practice with the help of this voltage we will charge the battery and then we use this voltage to light the small bulb. If we install this unit to the any small flyover then with the help of this voltage we generate a small voltage and with the help of this voltage we light the bulb.

In Figure 1, The arrangement of rack-pinion and dynamo below the speed breaker installed on a road of heavy traffic, shopping malls entrances or in parkings. The rack and pinion mechanism will transfer the reciprocating motion of speed breaker to the generator or we can say dynamo into rotationary motion.

The kinetic energy of moving vehicle can be utilized to produce power by using a special arrangement called Power Hump. Power Hump is a dome like device likely to be speed breaker.

Whenever the vehicle is allowed to pass over the dome it gets pressed downwards then the springs attached to the dome is compressed and the rack which is attached to the bottom of the dome moves downward in reciprocating motion. Since the rack has teeth connected to gears, there exists conversion of reciprocating motion of rack into rotary motion of gears.

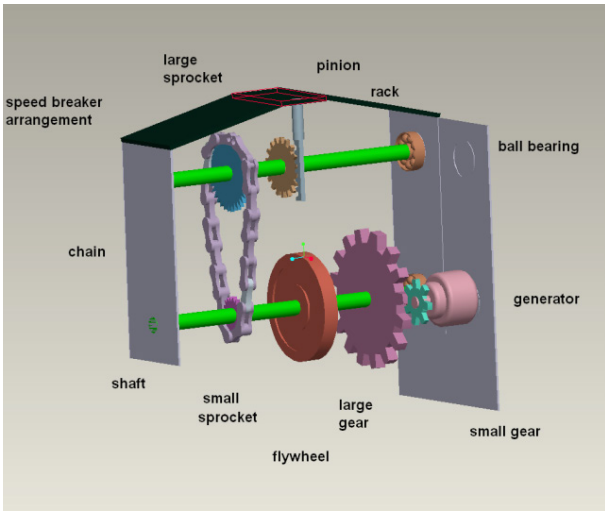


Figure 1.Arrangement of rack, pinion and dynamo below

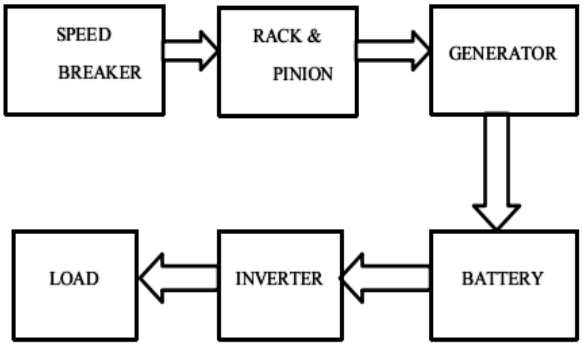


Figure 2.Block Diagram of Electricity Generation By Using Speed Breaker

A flywheel is mounted on the shaft whose function is to regulate the fluctuation in the energy and to make the energy uniform so that the shafts will move with certain rpm. these shafts are connected through a gear drive to the dynamo, which converts the mechanical energy into electrical energy. The conversion will be proportional to traffic density.

One rod i.e. rack with the dynamo is placed like a speed breaker. Dynamo means a generator that produces direct current with the use of a commutator. The dynamo uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current through Faraday’s law. A dynamo machine consists of a stationary structure, called the stator, which provides a constant magnetic field and a set of rotating windings called the armature which turn within that field. Movement of vehicle just rotates the dynamo shaft and electricity is generated. This voltage is to be stored in the chargeable battery.

Components

Dynamo

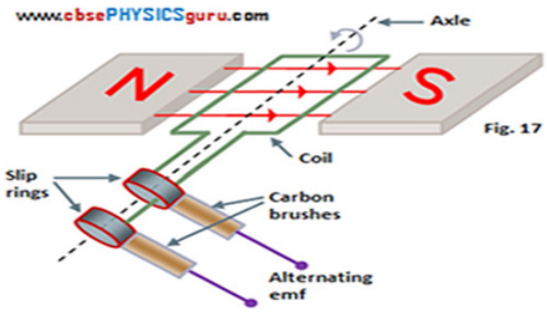


Figure 3.Dynamo

The dynamo uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current through Faraday's law.[2] A dynamo machine consists of a stationary structure, called the stator, which provides a constant magnetic field and a set of rotating windings called the armature which turn within that field. On small machines the constant magnetic field may be provided by one or more permanent magnets; larger machines have the constant magnetic field provided by one or more electromagnets, which are usually called field current.

The commutator was needed to produce direct current. When a loop of wire rotates in a magnetic field, the potential induced in it reverses with each half turn, generating an alternating current. However, in the early days of electric experimentation, alternating current generally had no known use.

The few uses for electricity, such as electroplating, used direct current provided by messy liquid batteries. Dynamos were invented as a replacement for batteries. The commutator is a set of contacts mounted on the machine's shaft, which reverses the connection of the windings to the external circuit when the potential reverses, so instead of alternating current, a pulsing direct current is produced.

Rack and Pinion

The rack and pinion mechanism has advantages over the other two. When compared with roller mechanism, the slip of the tyres over the speed breaker is avoided as is possible in roller mechanism. The slip of the tyres would pose more trouble to the vehicle user than the power generated. Now our project is to completely utilize the technique of using rack and pinion mechanism for power generation.

The model demands the conversion of the linear motion of the speed breaker to be converted into rotary motion for the generation of power. A mechanism that best does this job is the use of rack and pinion. Thus the rack employed meshes with the sprocket and does its job of motion conversion. To make the model cost effective and stronger, the usual rack and pinion mechanism is replaced by a chain tightly stranded to a wooden piece and a sprocket that meshes with the chain.

Flywheel

A flywheel stores energy that is based on the rotating mass principle. It is a mechanical storage device which emulates the storage of electrical energy by converting it to mechanical energy. The energy in a flywheel is stored in the form of rotational kinetic energy. The input energy to the FESS is usually drawn from an electrical source coming from the grid or any other source of electrical energy.

The flywheel speeds up as it stores energy and slows down when it is discharging, to deliver the accumulated energy. The rotating flywheel is driven by an electrical Motor-Generator (MG) performing the interchange of electrical energy to mechanical energy and vice versa. The flywheel and MG are coaxially connected, indicating that controlling the MG enables control of the flywheel.

Despite major developments during their early stages, the utilization of flywheels has not been significant and has declined with the development of the electric grid. However, due to the recent improvements in materials, magnetic bearings, power electronics and the introduction of high speed electric machines, FESS have been established as a solid option for energy storage applications.

Battery

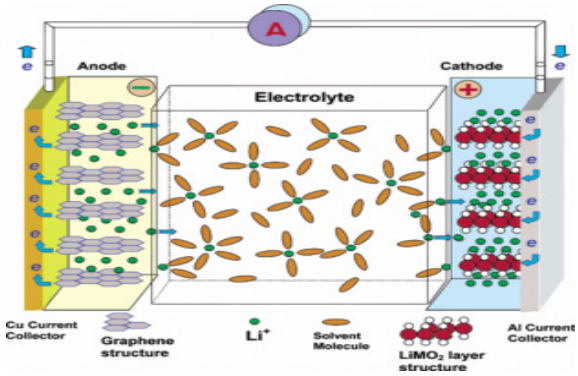
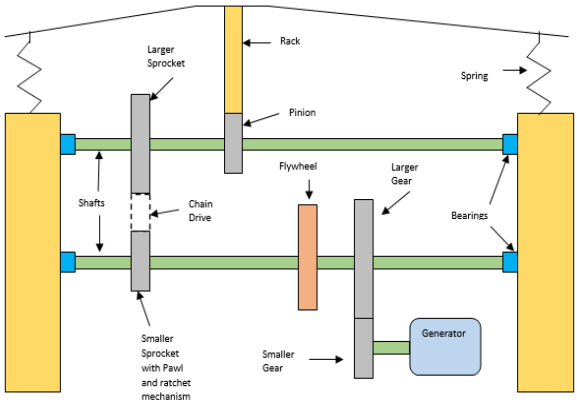


Figure 4.Battery

Basics of Lithium ion batteries Lithium ion battery consists of three main components, positive and negative electrode separated by a separator dipped in electrolyte. Negative electrode[7] is normally an electron donor group which is electropositive in nature like lithium metal. 6 Positive electrode is normally an electron acceptor which is strongly electronegative (e.g. LiMO2 (M= Co, Ni, Mn, etc) compounds). During discharge process, the negative electrode electrochemically oxidized and releases electron. This electron moves through outer circuit to the positive electrode which accepts electron. In Figure 4, the schematic of lithium ion battery operation is explained using LiCoO2 as positive electrode and carbon as negative electrode.



Design and Implementation:

The bearing is provided in order to permit the relative motion between the shafts. In this way vertical motion is to be converted into rotational motion. The one end of the shaft will be fixed with the help bearing. The working of this speed breaker arrangement for producing electricity is very simple. The ball bearings are connected in one side of roller in this project. At one side ball bearing is used to make the linear and smooth rotation of roller. At the second side synchronous AC motor has been connected through mechanical coupling. As the roller rotates because of vehicle motor also starts to rotate due to which electricity is being produced. . The speed breaker on a road will be lifted to some height from one side and fixed to the road from other side. Then there will be a shock absorber kind of mechanism beneath the speed breaker. There are a large number of automobiles running on the road. These automobiles go over a number of speed breakers present on the road.

The vehicle is having a variety of weight like trucks, buses, cars and two wheelers therefore whenever they are passing over a speed breaker a lot of energy is wasted. So when the vehicle will come on the speed breaker, electricity produced by dynamo which acts as a generator because it get rotated linearly with the speed breaker due to coupling of speed breaker with motor shaft. The generated voltage is DC which will charge the battery is then converted in AC using inverter. By increasing the capacity of the battery and the inverter circuit the power rating is increased.

This arrangement is fitted in highways; the complete arrangement is kept inside the floor level except the speed brake arrangement.Here we are making speed breaker which will be installed below, when a vehicle crosses the speed breaker the speed breaker will rotate on the basis of weight and the speed of the vehicle. At the output of motor rectifier is connected example bridge rectifier. That output of bridge rectifier is given to the boost converter. Through boost converter we can use the boost the voltage. The output of boosted voltage is given to the application which is being implemented such as street light and traffic light. The boosted voltage can also be given to the battery to store the electricity. Through battery we give supply to the port of microcontroller through which traffic light operates. Then the output of the battery is used to lighten the street lamps on the road. Now during daytime we don't need electricity for lightening the street lamps so we are using a control switch which is manually operated .The control switch is connected by wire to the output of the battery. The control switch has ON/OFF mechanism which allows the current to flow when needed.

Conclusion

It is a non conventional type of producing the energy. The existing source of energy such as coal, oil etc may not be adequate to meet the ever 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. Consequently sincere and untiring efforts shall have to be made by engineers in exploring the possibilities of harnessing energy from several non-conventional energy sources. This project is a one step to path of that way. The overall goal was to design the speed breaker System while keeping the engineering, producer and customer models in check. The reason why this feature was used more than all of the other features are because the other features would not have as much effect on the complete system. By changing the size and desirable price, weight and capacity can be realized.

- It can be implemented at metropolitan cities So that more electric power is produced.
- Arrangement of whole setup is easier.
- The stored electricity could satisfy the daily requirement of electric power.

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