ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Power Generation through Speed Breakers

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Abstract:

In the present scenario power becomes a major need for human life. Due to day-to-day increase in population and lessen of the conventional sources, it becomes necessary that we must depend on the non-conventional sources for power generation. While moving, the vehicles possess 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”. The kinetic energy of moving vehicles can be converted into mechanical energy of the shaft through rack and pinion mechanism. This shaft is connected to the electric dynamo and it produces electrical energy proportional to traffic density. The generated power can be regulated by using zener diode for continuous supply. All this mechanism can be housed under a dome like speed breaker, which is called hump.The generated power can be used for general purpose like street lights, traffic signals. The electrical output can be improved by arranging these power humps in series, this generated power can be amplified and stored by using different electric devices. The maintenance cost of hump is almost nullified.

I. INTRODUCTION:

An energy crisis is any great bottleneck (or price rise) in the supply of energy resources to an economy. It usually refers to the shortage of oil and additionally to electricity or other natural resources. An energy crisis may be referred to as an oil crisis, petroleum crisis, energy shortage, electricity shortage electricity crisis. While not entering a full crisis, political riots that occurred during the 2007 Burmese anti- government protests were initially sparked by rising energy prices. Likewise the Russia- Ukraine gas dispute and the Russia-Belarus energy dispute have been mostly resolved before entering a prolonged crisis stage. Market failure is possible when monopoly manipulation of markets occurs.A crisis can develop due to industrial actions like union organized strikes and government embargoes. The cause may be ageing over-consumption, infrastructure and sometimes bottlenecks at oil refineries and port facilities restrict fuel supply. An emergency may emerge during unusually cold winters. Emerging Shortages Crisis that currently exist include; • Oil price increases since 2003 - Cause: increasing demand from the U.S and China, the falling state of the U.S. dollar, and stagnation of

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production due to the U.S. occupation of Iraq. Iraq is #3 in the world (besides Saudi Arabia and Iran) for its oil reserves. However some observers have stated the global oil production peak occurred in December2005. If this is correct it is also to blame. • 2008 Central Asia energy crisis, caused by abnormally cold temperatures and low water levels in an area dependent on hydroelectric power.

Basic Principles

- Simple energy conversion from mechanical to electrical.
- To generate electricity using the vehicle kinetic energy as input
- we can develop electricity from speed breakers

They are using three different mechanisms

- Roller mechanism
- Rack- Pinion mechanism
- Crank-shaft mechanism

The energy crisis is a great bottleneck in the supply of energy resources to an economy. The studies to sort out the energy crisis led to the idea of generating power using speed breaker. Firstly South African electrical crisis has made them implemented this method to light up small villages of the highway. Since then a lot has been done in this field. The idea caught our working team and decides to develop such a project that will produce more power and store it for use at night time as it proves to be a boon to the economy of the country.

II. METHODOLOGY

Mechanisms

- Roller mechanism
- Rack- Pinion mechanism
- Crank-shaft mechanism

Roller Mechanism:

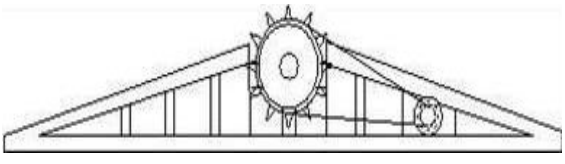

Fig 1: Roller Mechanism

Producing electricity from a speed breaker is a new concept that is undergoing research. The number of vehicles on road is increasing rapidly and if we convert some of the kinetic energy to these vehicles into the rotational motion of roller then we can produce considerable amount of electricity, this is the main concept of this project. In this project, 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 rotates the roller. This movement of roller is used to rotate the shaft of D.C. generator by the help of chain drive which is there to provide 1:5 speed ratios. As the shaft of D.C. generator rotates, it produces electricity. This electricity is stored in a battery. 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.

Problems with the Roller Mechanism

- Maintenance will be very difficult
- It might cause collision problems

Crank Shaft Mechanism

The crankshaft is a mechanism that transforms rotary movement in to linear movement, or viceversa. For example, the motion of the pistons in the engine of a car is linear (they go up and down).But the motion of the wheels has to be rotary. So, engineers put a crankshaft between the engine and the transmission to the wheels. The pistons of the engine move the crankshaft and the movement becomes rotary. Then the rotary movement goes past the clutch and the gear box all the way to the wheels.

Problems with the Crank Shaft Mechanism

Crank shafts are to be mounted on the bearing so it may cause balancing problem. Leading to mechanical vibration causes heavy damage.

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Rack And Pinion Mechanism

Fig 2: Rack and Pinion Mechanism

In the present scenario power becomes major need for human life. Due to day-to-day increase in population and lessen of the conventional sources, it becomes necessary that we must depend on non-conventional sources for power generation. While moving, the vehicles possess 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". The Kinetic energy of moving vehicles can be converted into mechanical energy of the shaft through rack and pinion mechanism. This shaft is connected to dynamo and it produces electrical energy proportional to traffic density. This power can be regulated by using zener diode for continuous supply. All this mechanism can be housed under the dome like speed breaker, which is called hump.

Electricity Generation from Roller Mechanism

Generating Electricity from a Speed breaker First of all what is electricity means to us? Electricity is the form of energy. It is the flow of electrical power. Electricity is a basic part of nature 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 coal, natural gas, oil, nuclear power and other natural sources, which are called primary sources.

Electricity Generation from Rack And Pinion Mechanism

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

While moving, the vehicles possess 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".

The Kinetic energy of moving vehicles can be converted into mechanical

Construction Details

The various machine elements used in the construction of power hump are

- Rack
- Sprocket Gear
- Shaft
- Springs
- Electric Dynamo
- Bearings

Rack

Fig 3: Rack

Its primary function is to convert translator motion into rotary motion. It must have higher strength, rigidity and resistance to shock load and less wear and tear. Rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. The circular pinion engages teeth on a linear "gear" bar ± the rack. Rotational motion applied to the pinion will cause the rack to move to the side, up to the limit of its travel.

Sprocket Gear:

It is used to transfer rotary motion between two shafts. A sprocket or sprocket wheels a profiled wheel with teeth, cogs, or even sprockets that mesh witha chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it.

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It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth.

Shafts

It is a rotating element, which is used to transmit power from one place to another place. It supports the rotating elements like gears and flywheels. It must have high torsional rigidity and lateral rigidity.An automotive drive shaft is responsible for transferring the engine's rotational power, or torque, through the transmission across some distance to one of the car's axles, either from the front of the car to the rear or vice versa. A car's engine cannot power all of the wheels alone. In a front-wheel drive vehicle. It is therefore connected under the hood to a transmission, which then must be linked to the car's rear axle via a long drive shaft running the length of the car.

Fig 4: Shaft Springs

Fig 5: Helical Spring

It is defined as 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. Springs are used for many purposes, and one spring may serve more than one purpose. Listed below are some of the more common of these functional purposes.

Fig 6: Assembled Springs

Bearings

Fig 7: Bearings

It is a machine element, which supports machinery. It permits relative motion between the contacting surfaces while carrying the loads. They reduces transmit the motion effectively. The basic function of bearings is principally to reduce mechanical friction.

Electric Dynamo:

It is a device, which converts mechanical energy into electrical energy. It works based on “faraday’s laws of electromagnetic induction” A dynamo, originally another name for an electrical generator, now means a generator that produces direct current with the use of a commutator. Dynamos were the first electrical generators capable of delivering power for industry, and the foundation upon which many other later electric-power conversion devices were based, including the electric motor, the alternating-current alternator, and the rotary converter.

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They are rarely used for power generation now because of the dominance of alternating current, the disadvantages of the commutator, and the ease of converting alternating to direct current using solid state methods. The word still has some regional usage as a replacement for the word generator. A small electrical generator built into the hub of a bicycle wheel to power lights is called a Hub dynamo, although these are invariably AC devices.

Fig 8: Electrical Dynamo

III. WORKING PRINCIPLE:

While moving, the vehicles possess 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. It is an Electro-Mechanical unit. It utilizes both mechanical technologies and electrical techniques for the power generation and its storage. 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 are 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 but the two gears rotate in opposite direction. 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 rotate with certain R.P.M. these shafts are connected through a belt drive to the dynamos, which converts the mechanical energy into electrical energy.

The conversion will be proportional to traffic density. Whenever an armature rotates between the magnetic fields of south and north poles, an E.M.F (electro motive force) is induced unit. So, for inducing the E.M.F. armature coil has to rotate, for rotating this armature it is connected to a long shaft. By rotating same e.m.f, is induced, for this rotation kinetic energy of moving vehicles is utilized. The power is generated in both the directions; to convert this power into one way a special component is used called zenor diode for continuous supply. All this mechanism can be housed under the dome, like speed breaker, which is called HUMP. The electrical output can be improved by arranging these POWER HUMPS in series. This generated power can be amplified and stored by using different electrical devices.

Power Generation through Speed Breakers

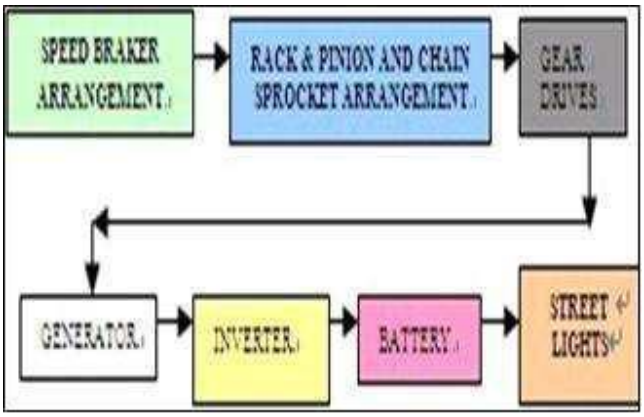

Fig 9: Block Diagram of Project

Advantages:

- Low budget electricity production
- Less floor area
- No obstruction to traffic
- Easy maintenance
- Suitable at parking of multiplexes, malls, toll booths, signals, etc.
- Uses: Charging batteries and using them to light up the streets etc.
- Pollution free power generation.
- Simple construction, mature technology, and easy maintenance.
- No manual work necessary during generation.

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- Energy available all year round.
- No fuel transportation problem.
- No consumption of any fossil fuel which is non-renewable source of energy.

Limitations

- Selecting suitable generator.
- Selection of springs.
- Achieving proper balance of speed and torque.
- It gives low electric output.
- We have to check mechanism from time to time.
- It can get rusted in rainy season.
- It will not work with light weight vehicle.

Project View

Fig 9: Project view

Specifications

Specifications of Pinion

Material – Stainless Steel (303S31)
Radial Diameter 'D 2' – 58mm
Number of teeth 'T 2' – 35
Module = D2/T2 = 1.65
Pressure Angle = 20º
Circular Pitch – 4.172mm

Design Calculations

Design Calculations for springs
Material of the spring = ASTM A228 Steel (G=80 Gpa)
Wire dia of the spring, d = 6mm
Outer diameter of the spring,
D = 60mm Length of the spring, l = 240mm
Number of coils n = 08
Mean coil diameter = D-d= 60 -6 = 54mm
Stiffness of the spring $k = G \times d^4 / 8 \times D^3 \times n$ = (80 × 10 ^{4} × (6) 4)\(8 × (54) ^{3} ×08)

=6.9 N/mm

Stiffness of springs k = load/deflection Therefore, load, w = k ×deflection
= 6.9 × 60 = 414 N (We assume maximum deflection = 60mm)
As we are using two springs of same specification total load W = 2 × w
= 2 × 414 = 828 N = 84.4 kg.
Calculation of Speed Multiplication
Speed ratio = T2/T1 = 18/22
N1/N2 = 0.81
Where, N1 = speed of the gear N2 = speed of the pinion
T1 = number of teeth in gear
T2 = number of teeth in pinion N2 = N1/0.81
If the speed of the gear N1 is 20 RPM then,
The speed of the pinion N2 = 20 / 0.81 =24.69RPM

Calculation of torque

Torque
T = force × perpendicular distance
=828× 30×10 $^{-3}$ (perpendicular distance= 30mm)
=24.840 N-m
Torque obtained at the pinion = 24.84 / 3.42
= 7.26 N-m

Test Procedure

The following are the steps to check the project

- The setup is to be installed at the speed breaker where the traffic or vehicle moment is high.
- Then the vehicles are allowed to flow over the setup.
- When the vehicle runs then the springs get compressed.
- The load on the setup is directly proportional to the voltage produced.
- As the springs compress then the motion is converted into linear and then the linear into

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
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rotary.

- Then the voltage reading in the multi meter is noted down then the voltage is multiplied by current in the circuit to get power generated.
- In this way many trials are done for different speeds and then the power generated is calculated.
- In this way the testing goes on.

IV. RESULTS AND DISCUSSIONS:

The voltage generated at different load Conditions are observed and readings are tabulated as shown below.

Table No. 1 Result Table for Load and Voltage

Load (Kg)	Voltage (V)
60	4.43
130	6
170	9
200	11
270	12

These are the results obtained when the project is allowed to test under different loads and speeds. The efficiency can be greatly achieved when the capacity of the project and also the capacity of the components is increased. The power generated can be increased when the frequent loads or vehicles passing over it are more in number.

V. CONCLUSION:

As the conventional source are depleting very fast, then it's time to think of alternatives. We got to save the power gained from the conventional sources for efficient use. So this idea not only provides alternative but also adds to the economy of the country. Now vehicular traffic in big cities is more, causing a problem to human being. But this vehicular traffic can be utilized for proper generation by means of a new technique called "power hump". It has advantages that it does not utilize any external source. Now the time has come to put forte this type of innovative ideas, and also researches should be done to upgrade its implication. In future, if the flywheel speed control device and voltage protection devices are added with large generation process, it would be a model all over the world. After some modification of the designed project, the efficiency of the whole system can be increased by increasing the capacity of the generator and applying more weight.

FUTURE SCOPE:

The gear transmission can be replaced by a series of chain drives for more power production. A provision can be made for storing the generated power in a battery and utilizing in future. Stress analysis can be carried out on the speed breaker. Speed breaker can be designed in a more compact manner in order to resist the heavy load.

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