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Design and Analysis of Power Generation

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Abstract: Electricity is the basic need in this modern world. This paper presents the concept of Road Power Generator (RPG) project that deals with the mechanism to generate electricity from the wasted kinetic energy of vehicles. It contains sliding plate, gear arrangement, flywheel, sliding mechanism, rack and pinion mechanism, and finally generator coupled at the end of flywheel shaft where rotational motion is generated, thus electricity generated. This project can be installed at highway where more amount of heavy traffic pass daily, thus with the help of this project the huge amount of electricity can be generated. The utilization of this electricity for different types of application such as street lighting, battery charging units, domestic purpose, etc.

Keywords: Rack and pinion, Sliding plate, Wasted energy, Flywheel

I. INTRODUCTION

The increase in the demand of electricity and the recent change in the environmental conditions such as global warming led to a need for a new sources of energy. Today our whole life style is dependent on electricity. With the increasing population the use of electric power is also increasing. But we know that the resources to generate electricity are limited, and this has lead to the energy problem. During this present scenario we need to generate electricity from the things used in day-to-day life. The automobile industry in India is one of the largest in the world and the fastest growing globally. As we know that energy can be converted from one form to another form. This RPG device converts the wasted kinetic energy of the vehicles into electric energy. This is done by with the help of these project, the moving plate installed on the road, this plate take the stroke motion of the vehicles and convert it into the rotary motion by rack and pinion mechanism and it generates the electricity. The proposed design offers pollution free power generation, would cause no obstruction in traffic, causes to low budget electricity production. It would occupy less floor area and its maintenance would be easy. The power generated by this project can be used in street lights, road signals, lighting of the bus stops, etc.

II. LITERATURE REVIEW

The energy crisis is a 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. First to make use were South African people, their electrical crisis has made them to implement this method to light up small villages of the highway. The idea of basic physics to convert the kinetic energy into electrical energy that goes waste when the vehicle runs over the speed-break was used.

Recently several attempts and models have been suggested and tested for harnessing kinetic energy of vehicles via a speed bump. Mechanisms which include springs by A.K. Singh, Deepak S., Madhawendra K. and V. Pandit Rack and Pinion by Aswathaman. V, Priyadharshini. M, Shakun Srivastava , Ankit Asthana in “Produce electricity by the use of speed Breakers” and by Ankit Gupta, Kuldeep Chaudhary & B.N Agrawal in “An Experimental study of Generation of Electricity using Speed Breaker”. Slide crank by Noor Fatima and Jiyaul Mustafa in “Production of electricity by the method of road power generation” have been suggested for producing electricity.

Electrodynamics based models by Ankita and MeenuBala in ”Power generation from speed breaker” have also been suggested, but are not only expensive to fabricate but involve complicated calculations and can’t be used a large scale very easily. Totaram uses a platform plate which is kept inclined on a raised base level to allow vehicles to pass over the raised surface.

III. PROBLEM IDENTIFICATION

The rising demand of electricity due to rapid industrialization, need for electricity is increasing very rapidly. Power plants though are efficient but could not meet the growing requirement. Thus, there is a need of system which can support the power plant to meet the requirement. So, we develop a model which is nonconventional source of energy which can be used supplementary with power plant and can reduce the dependency on power plant to some extent.

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IV. OBJECTIVE

Our objective behind this project is to make a unit which can solve the problem of energy crisis. Our aim is to reduce energy crisis by using this unit to develop power in economical and convenient way. This can be achieve by implementing this unit where there is a heavy traffic like toll plazas, malls, Multiplexes, Traffic signals, Parking areas, etc.

V. WORKING PRINCIPLE OF RPG

The working principle of power generation unit is based on working of rack and pinion arrangement by vehicle passing over the plate arrangement. When the vehicle passes over the plate rack moves forward and backward direction with the help of sliding mechanism which transmits the motion to pinion. By using gear assembly motion is transmitted from main shaft to another shaft on which flywheel is mounted. The purpose of flywheel is to maintain constant speed and reduce the shock. The flywheel is then connected to generator where the actual electrical power is generated. Thus, basic principle is to convert Mechanical energy to Electrical Energy.

VI. COMPONENTS REQUIRED

A. Rack And Pinion Gears

The selection of rack and pinion used in the power generation unit is based on load applied on the unit and the material of the rack and pinion.

Fig.1. Rack And Pinion Assembly

B. Pedestal Bearings

Bearing is used to mount the shaft used in power generation unit. The purpose of it is to reduce the friction between shaft and the casing. Thus, they reduce the friction and transmit the motion.

Fig.2. Pedestal Bearings

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C. Fly Wheel

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

Fig.3. Fly Wheel

D. 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.

E. Generato

It is a device, which converts mechanical energy into electrical energy. The generator uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current. A generator consists of a stationary structure, called stator, which provides a constant magnetic field, and a set of rotating winding called the armature which turns within that field

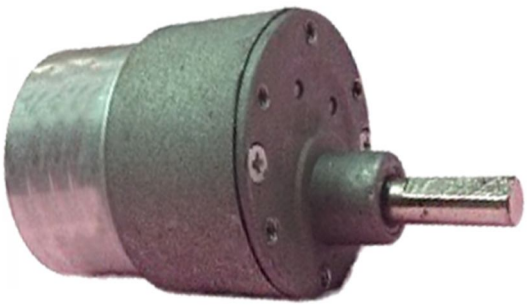

Fig. 4. Generator

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F. Sprocket and Chain Assembly

Sprocket is used to transmit power in one direction only. During forward motion pinion is rotated in one direction but during backward motion of rack, pinion is freed due to which no motion is transmitted. Chain and sprocket assembly are used to transmit motion from pinion shaft to flywheel shaft.

Sr.No.	Component	Quantity
1	Rack & Pinion	1
2	Generator	1
3	Shaft	2
4	Pedestal Bearing	2
5	Sprocket	2
6	Flywheel	1
7	Coil Spring	2
8	Chain Drive	1
9	Metal Sheet	-
10	M.S. Frame	1
11	Telescopic Slider	1

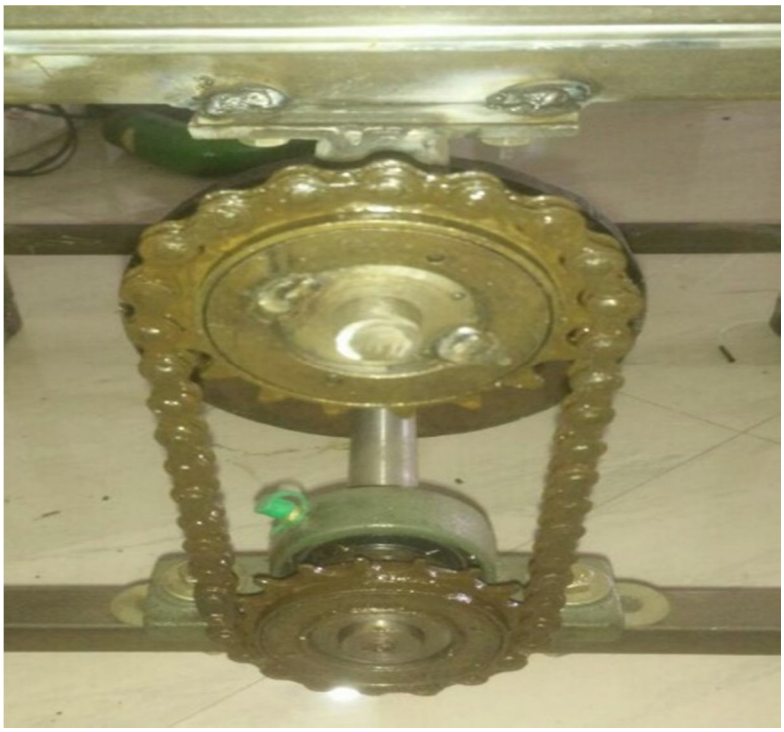

Fig.5. Sprocket and Chain Assembly

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VII. Model

Table.1. Bill of Component

VIII. BLOCK DIAGRAM

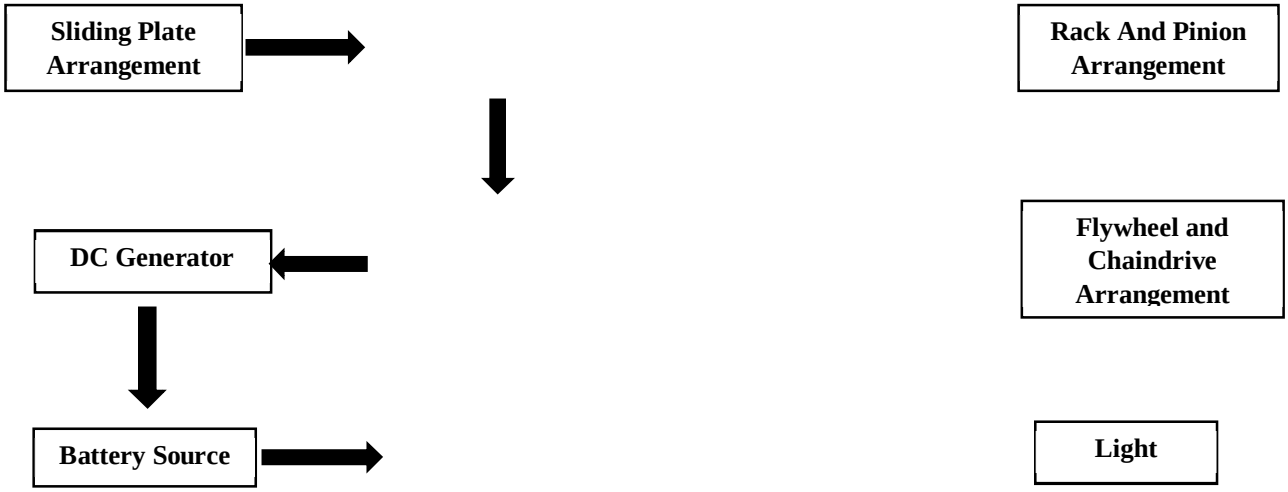

Fig.6. Block Diagram of RPG System

IX. OUTPUT POWER CALCULATIONS

The tractive force between a bike wheel and the surface can be expressed a

$$F = \mu_t W$$

$$= \mu_t m g$$

where,

F = traction effort or force acting on the wheel from the surface (N)

μ_t = friction coefficient between the wheel and the surface

W = weight or vertical force between wheel and surface (N)

m = mass on the wheel (kg)

g = acceleration gravity (9.81 m/s^2)

Assume μ for concrete road = 0.9

W= 150kg

F_{one_wheel} = 0.9 {(150 kg) (9.81 m/s^2) / 2}

= 662.175 N

Thus for one vehicle

Work done = Force x Distance x 2

= 662.175 x 0.05 x 2

= 66.21 J

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Power developed for 1 vehicle passing over the Plate arrangement for one minute = Work done / Sec

= 33.10 / 60

= 1.10 watts

Power developed for 60 minutes = 66.21 Watts

X. FUTURE SCOPE

As the demand for electricity is increasing day by day due to rapid industrialization & urbanization, load on power plant is increasing rapidly. This has resulted in load shedding problem in many areas. There is insufficient supply of electricity. To meet this requirement, research are going on to find alternative methods of power generation by using different sources like solar, wind, thermal, tidal, kinetic energy, Geothermal energy etc. Thus, our project aims at future requirement of electricity by using non-conventional source of energy i.e.kinetic energy of vehicles passing over this unit.

XI. CONCLUSION

Since, today electricity crisis is increasing rapidly so we have to develop a non conventional power producing unit which can overcome the crisis of electrical energy, which can use the waste kinetic energy of vehicle due to the friction between tyre of vehicles and road. This will support the power generating method and will tackle the problem of energy crisis.

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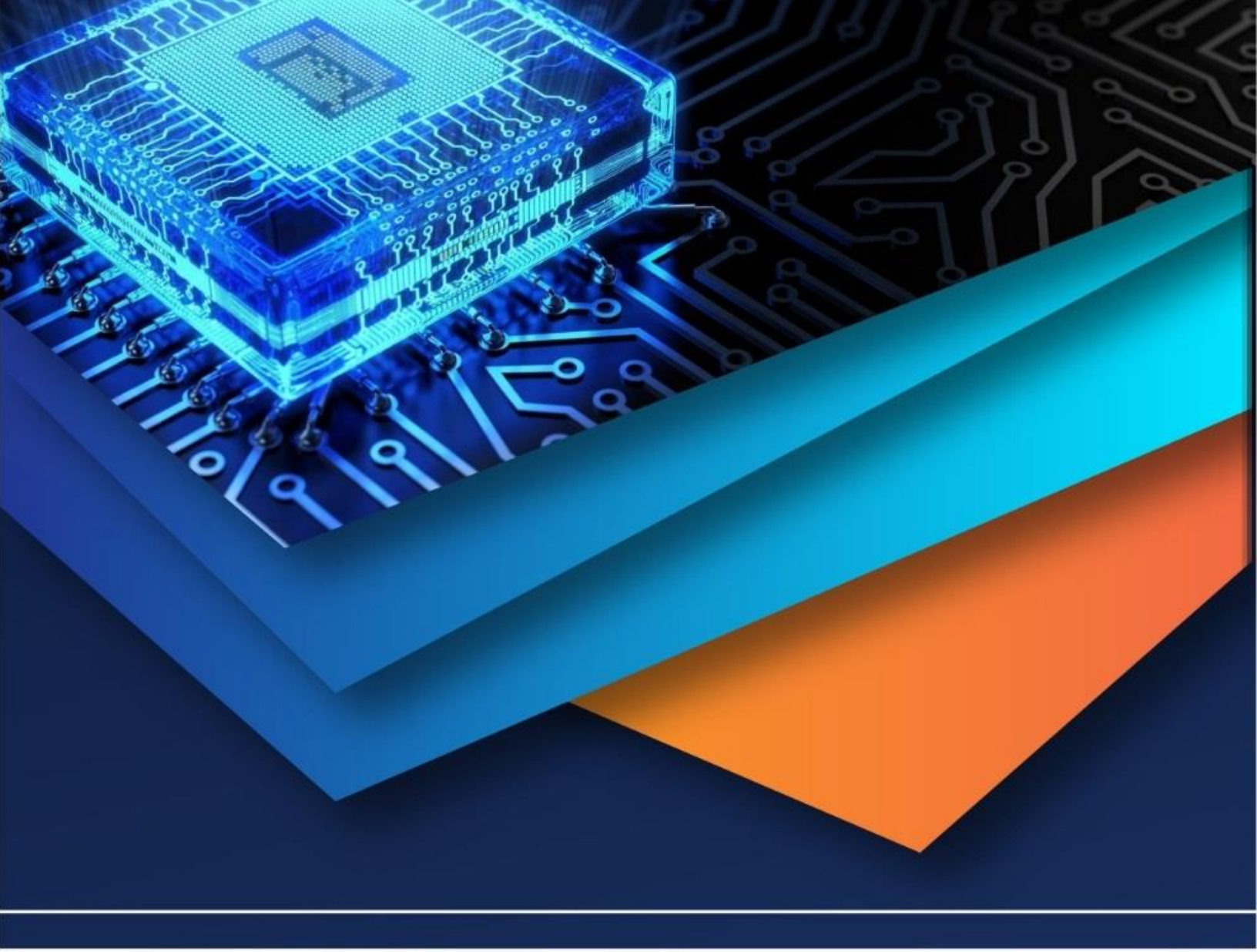

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