

ROAD POWER GENERATION SYSTEM BY USING FLIP PLATE MECHANISM



A Thesis

by

Dipangkar Roy; ID: BME1901017102

Bishwashwor Roy; ID: BME1901017620

Sourav Mondol; ID: BME1901017564

Azharul; ID: BME1901017580

Debashis Roy; ID: BME1901017583

Department of Mechanical Engineering
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Debashis Roy; ID: BME1901017583

Supervisor: Niloy Sarker

Lecturer

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"The Authors"

DECLARATION

We hereby, declare that the work presented in this project is the outcome of the investigation and research work performed by us under the supervisor of **Mr. Niloy Sarkar, Lecturer, Department of Mechanical Engineering, Sonargoan University (SU)**. We also declare that no part of this project and thereof has been or is being submitted elsewhere for the award of any degree.

Mr. Niloy Sarkar

Lecturer

Department of Mechanical Engineering

Sonargoan University (SU).

ABSTRACT

Food, clothes and shelter are the basic need of human beings. Now a day's electricity also the basic need of people. Electricity is one of the most important parts of humankind. Our Bangladesh is a developing country. So, for development of domestic and industrial purpose there is huge demand of electrical energy. The electricity is the most popular form of energy and its demand in the country has been increasing day by day. There are two type of energy generation conventional and non-conventional. Conventional energy sources are solar energy, wind energy, hydro power energy, tidal energy etc. Nonconventional energy sources are coal energy, thermal energy, nuclear energy etc. But all conventional and non-conventional energy sources require high installation cost. Also, all conventional sources are based on environmental conditions. Our main motto is to design a conventional source that will overcome this entire drawback. In this paper we are designing such model using flip plate which generate the electricity. For generation of electricity we have to use DC generator with flywheel and produced electricity is stored in DC battery. This stored electricity is used for lightning purpose. This system is installed on the road where continuous flow of vehicles is present. They can also be used in local power generation, street lightning.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Electricity is the important part of our daily life. It is a basic need for home and industries. All the devices of home, business, schools, colleges, hospitals, market area, temples etc. are dependent on the electricity. Electricity was generated from various conventional energy sources and non-conventional energy sources. Mostly the conventional energy sources like hydro power plant and thermal power plant are the maximum sources of electricity. Similarly, electricity is obtained from other sources like solar, wind, natural gases, tidal etc. which are non-conventional. Mostly the hydro power plant and thermal power plant is used for base load which require the more time for the start and shut down the plant. And other non conventional sources are used for small applications in most of the time.[3]

Day by day, requirement of electricity is increasing. Also, the use of vehicles is increasing. Some of them affect nature. There are number of vehicles passing on the road every day. The kinetic energy of vehicles wasted on road in the form of friction. We have to utilize this wasted energy. There are various methods to capture this energy. Such as piezo electric, speed breakers are installed practically. But electricity generation from flip plate is new technology and research is going on it. [9]

So, we are designing such system which belongs to above concept and also helpful for society. So, we are designing such a system which will not pollute nature also require less floor area and will not need of fuels for its operation. This system gives pollution free electricity, no barrier to traffic, minimum maintenance cost, also less floor area is required. So, we have to design such system which belongs from above concept also helpful for society. So, we have to design such a system which cannot pollute nature also require less area and no need of fuel. This system gives pollution free electricity, no barrier to traffic, minimum maintenance cost, also less area required.[6]

1.2 AIM OF THE PROJECT

- For meeting up the regular demand of energy we want to design a system which will produce without destroying the nature.
- Generating power by sustainable mechanism which can be installed on the smooth road.
- The implementation of road power generator units on highway and busy traffic roads of the city.

1.3 OBJECTIVES OF THIS PROJECT

- To design and development a mechanism which minimize energy crises.
- To provide the free electricity to near grid station, street lights, sign boards, and traffic signals etc.
- To provide electricity to the rural areas too.
- To provide electric power without any fuel cost.
- To design noise less mechanism.
- To have the less impact on the environment.

CHAPTER 02

LITARETURE REVIEW

A large amount of kinetic energy is being wasted on roads on daily basis in different forms which could be use to generate power and this power can be stored in batteries. This paper shows clearly how we can generate power by using rack-pinion method where basically linear motion is converted into rotary motion and then can be used to generate electricity. Large amount of electricity can be generated using this method and this method is ecofriendly.

The principle of the electric power generation using. Flip plate mechanism is very simple. It is based on the same principle as in the case of electricity generation in case of hydroelectric power plant, thermal electric power plant, nuclear power plant, geothermal energy, wind energy, tidal energy etc. In all of the above power plant mechanical energy is converted into electrical energy. In this setup also, mechanical energy is converted into electrical power using a D.C. generator. Here the vertical motion of the top of the Flip Plate is converted into the rotational motion, which in turn rotates the generator and generates electricity.

The proposed design offers pollution free power generation, would cause no obstruction in traffic, leading to low budget electricity production. It would occupy less floor area and its maintenance would be easy. The power generated by this technique can be used in street lights, road signals, lighting of the bus stops, lighting of the check post on the highways, etc. As identified by Aswathaman, 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.[3]

Singh et al.[7] discussed rack pinion mechanism to generate electricity. They proposed mechanism using chain sprocket and springs with rack pinion to generate electricity. Vehicle was passed over that mechanism and then due to rack pinion there was rotation in gears and shafts moved with chain sprocket movement. Dc power was generated and was stored in a battery and then using an inverter they changed that dc in ac power.

Das et al.[8] proposed mechanism in which electricity was produced by rotating energy of roads. The basic principle was when a car passes over the flip plate which

is the device use in place of the road will go to backward move the flip plate while this 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 the shaft whose function was to make energy uniform. That shaft is connected through a spur gear with dynamos. These dynamos were used to convert mechanical energy in electrical energy. The power was generated in both directions.

CHAPTER 03

PROBLEM STATEMENT

In our country the electricity generated from the renewable sources. For example, solar energy, wind energy etc. but not every form of renewable energy is commercially available. Also, they are less efficient, depends on environmental conditions. Also, they all are location specific and requires storage capabilities. They require large space for installation. Now a day's demands of electricity in countries are increasing. All devices are working on the electricity. Also, the use of vehicles increasing day by day. There is continuous flow of vehicles on the roads. So, more tons of energy wasted in the form friction. By capturing this energy, we have to convert it into useful electrical energy. We have to design such system which requires less space and low installation cost. Generation of electricity is not affected by any environmental conditions.

CHAPTER 04
METHODOLOGY

Road power generation is a system that is designed to convert waste kinetic energy of vehicles to electrical energy. The flip plate mechanism is used for the conversion of the energy, the flip plate perform the to and fro motion due to the speed of the vehicles and the flip plate is connected to the gear mechanism through shaft and generate electricity. While it is connected to the street light. Here we re use this components such as flip plate, fly wheel, spur gear, shaft, rack and pinion etc.

4.1 BLOCK DIAGRAM

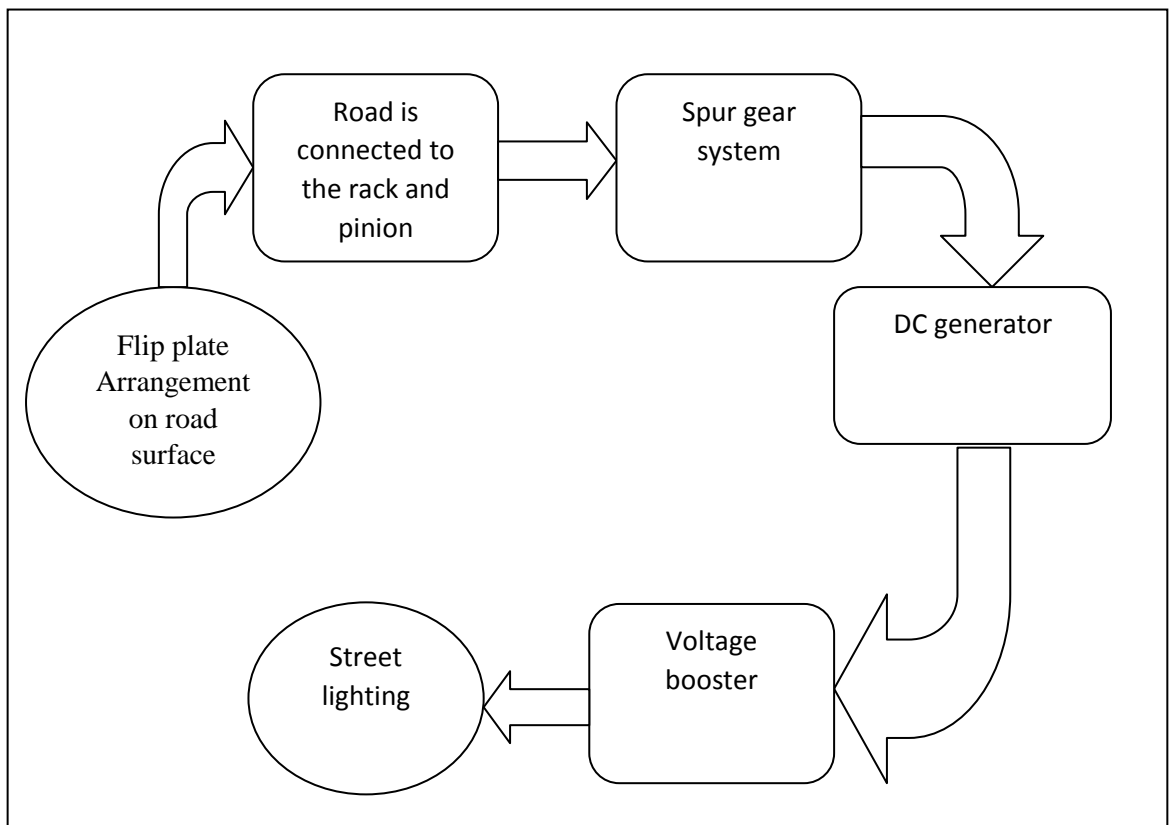


Fig4.1: Block Diagram

4.2 FLIP PLATE

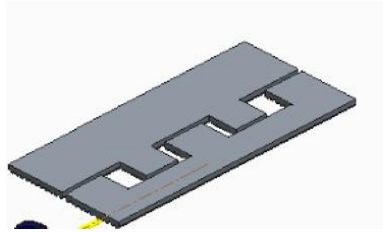


Fig 4.2: Flip plate

Flip plate mechanism working process is it moves forward and backward stroke at the limited distance. This plate mounted on the road surface. As wheel of the vehicle reaches upper most position of the plate, plate get slide toward guide.

4.3 RACK & PINION GEARS



Fig 4.3: Rack and pinion

A rack and pinion is a type of linear actuator that compares a pair of gear which converts rotational motion into linear motion. A circular gear is called pinion.

4.4 SPUR GEARS



Fig 4.4: Spur gear

Spur gears are the simplest and most common type of gear. Their general form is a cylinder or disk. The teeth project radially, and with these straight-cut gears, the leading edges of the teeth are aligned parallel to the axis of rotation. These gears can only mesh correctly if they are fitted to parallel axles. The torque ratio can be determined by considering the force that a tooth of one gear exerts on a tooth of the other gear. Consider two teeth in contact at a point on the line joining the shaft axes of the two gears. The force will have both a radial and a circumferential component. Gears are a very useful simple machine. The torque ratio can be determined by considering the force that a tooth of one gear exerts on a tooth of the other gear. Consider two teeth in contact at a point on the line joining the shaft axes of the two gears.

4.5 SHAFTS



Fig 4.5: Shaft

Shafts are rotating members that transmit power through them. They are splined or slotted for a properly transmitting power and also acts as a coupling medium.

4.6 FLY-WHEEL



Fig 4.6: Fly wheel

A fly-wheel is a mechanical device specifically designed to efficiently store rotational energy. Fly-wheel resists changes in rotational speed by their moment of inertia. The amount of energy stored in a fly-wheel is proportional to the square of its rotational speed.

4.7 CHAIN DRIVE

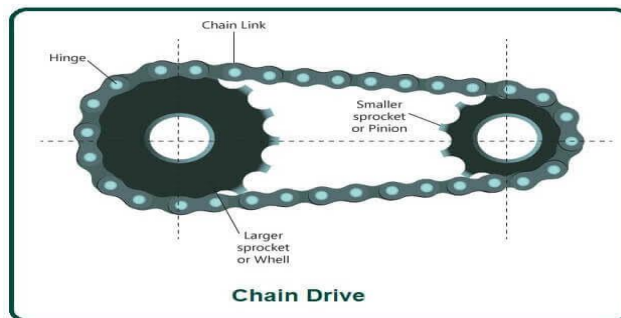


Fig 4.7: Chain drive

Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles. The power is conveyed by a roller chain known as the drive chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force.

4.8 D.C GENERATOR SPECIFICATIONS



Fig 4.8: DC generator

- 300 RPM at 12V D.C generator
- 2mm shaft diameter
- Motor Diameter: 28.5 mm
- Length 63 mm without shaft
- Shaft length 15mm
- 300gm weight
- 10kgcm torque
- No-load current = 800 mA(Max), Load current = upto 9.5 A(Max)

CHAPTER 05

WORKING PRINCIPAL

5.1 Working process

Road Power Generation (RPG) is a system design to capture waste and kinetic energy from all vehicles. This device converts the kinetic energy of the vehicles into electric energy. This is done by moving plate installed on the road, this plate captured very small movement from the road surfaces and it transferred to a key way flywheel system. From hundreds of wheels lies a single flywheel having used to driving machinery.

The RPG included the method of driving one flywheel to another, once it reached predetermining velocity. The RPG flywheel system has been developed to achieve large amount of moment of inertia in relatively small space. The captured energy is converted into electricity which is fed into power grid. In this paper the two flip plates are mounted on the road surface and these plates are followed by the rack and pinion arrangement. Pinion is mounted on the shaft which is attached to the frame via bearing. Frame is installed under the road. The flywheel with pulley is mounted on the shaft and second pulley is mounted on the D.C generator are connected with the help spur gears.

As wheel of the vehicle reaches upper most position of the plate, plates get slide through guide, simultaneously rack moves forward and backward provide torque to pinion. The pinion transmitted this torque to shaft. Shaft is supported by two bearings attached on wall of frame.

The shaft having pulley and flywheel arrangement on shaft through one way bearing. This arrangement functions to enhance rotation of flywheel for small motion of shaft. The bigger spur gear coupled with smaller spur gear mounted on the D.C. generator shaft. The d. c. Generator converts the rotation of smaller pulley into electricity.

5.2 WORKING PROCESSFLOW CHART

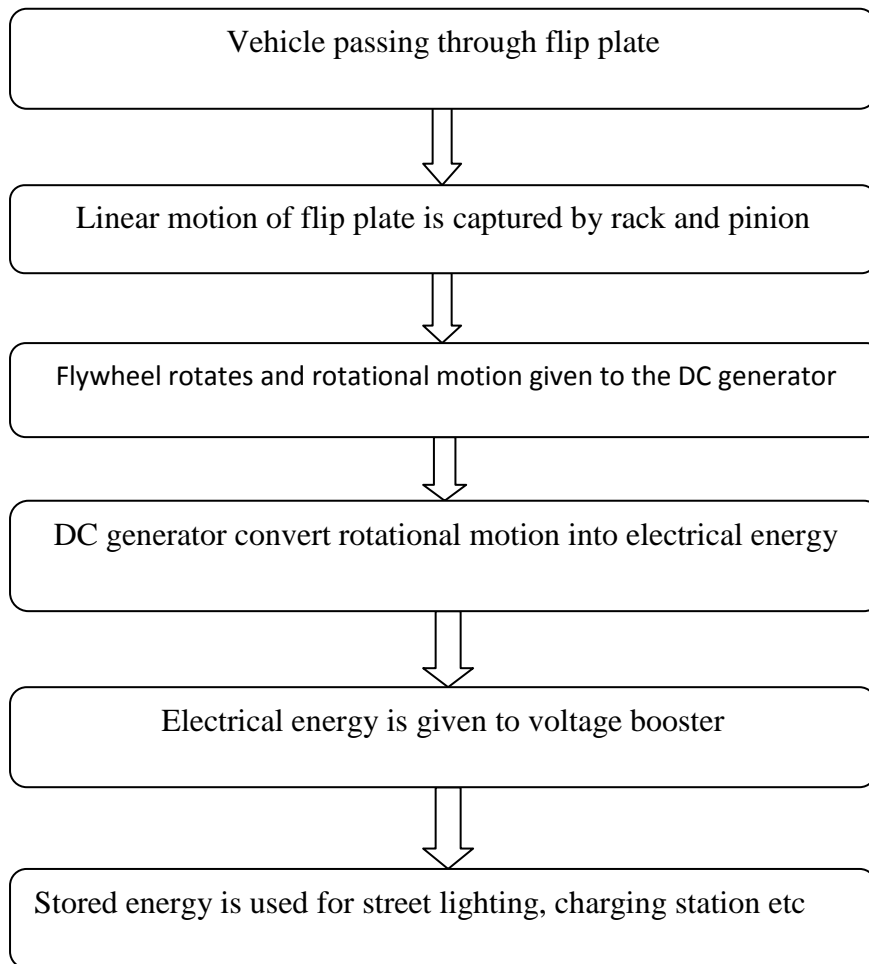


Fig 5.2: Flow Chart

CHAPTER 06

MODEL

6.1 2D MODEL

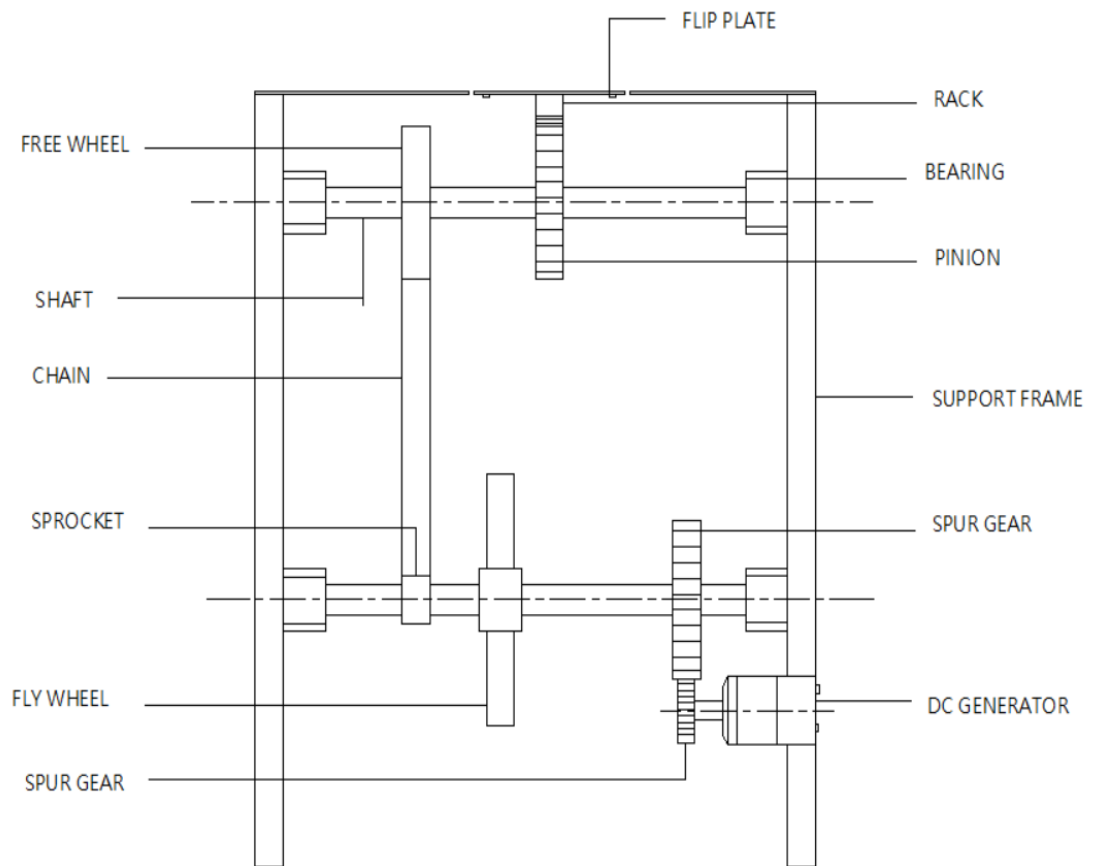


Fig 6.1: 2D RPG

6.2 HARDWARE MODEL



Fig 6.2: Hardware model

CHAPTER 07
DESIGN CALCULATIONS

7.1 DESIGN OF GEAR RATIO

$$Z1=32$$

$$Z2=62$$

$$Z3=22$$

$$Z4=16$$

$$Z5=52$$

$$Z6=21$$

first gear ratio =1.375 second gear ratio =2.476

Drive pulley of diameter=22mm, driven pulley=16mm

First gear ratio

$$22 / 16$$

Second gear ratio Third gear ratio Total gear ratio Pulley ratio

$$52 / 21$$

$$1.375 \times 2.476$$

Total ratio= Total gear ratio x Pulley ratio = 4.3x 2.46 = 10.67 turns

In this, rack is moved for the distance of approximately 60mm in which the chain roller pitch is 10mm which will engage with the free wheel sprocket of diameter 80mm with 18 numbers of teeth on all around the gear.

Since rack is engaging, the teeth for 60mm length stroke, with 10mm pitch, so 6 numbers of teeth are getting engaged with the rack which is having 18number of teeth. So the first gear is rotating for $360 \times 6 / 18 = 120$ degree.

If the first gear or Z1 was rotating for one full turn, then the final gear rotation was for 10.67 turns.

Now since it is rotating for 120 degree instead of 360 degree.

7.2 POWER CALCULATION

Assume the weight of the vehicle (two-wheeler) =300kg

Average speed of the vehicle=25 km/hr.

Maximum moves of the plate =10cm

By using the above consideration mass of vehicle over the flip plate=300 kg

Height from the road surface=10cm

Work done=force*distance

But, distance=10cm=0.1m

Force=mass*acceleration due to gravity

$$=300*10$$

$$=3000 \text{ N}$$

Therefore, Work done=3000*0.1=300 watt

So that it is a power developed for 1 vehicle passes through flip plate in 1 min. = 5 watt

Power developed for 1 hr. (60 min) =300 watt

If the flip plate getting the continuous flow of vehicle supply then the power developed in 24 hrs. Is,

$$300*24=7.2\text{kw/day}$$

This output is getting when the continuously flip plate is on the working condition. Their motion is continuous if the continuous supply is getting to it.

CHAPTER 08
RESULT ANALYSIS

On the basis experimental results, we find some result variation due to different types of speeds. Some energy decrease because of friction for mechanical components. Such as rack and pinion , chain drive, spur gear and bearing. Flywheel resists changes in rotational speed by their moment of inertia and storage the rotational energy. That's why we are get the variation of results.

8.1 Performance Test of the project

| Output | | | |
|----------------|-------------------|-------------------|----------------|
| Sr. No. | AC Voltage | DC Voltage | Current |
| 1 | 0.32v | 3.2v | 30mA |
| 2 | 0.49v | 10.1v | 40mA |
| 3 | 0.51v | 18v | 50mA |
| 4 | 0.61v | 23.4v | 60mA |

8.2 Performance Test Graph

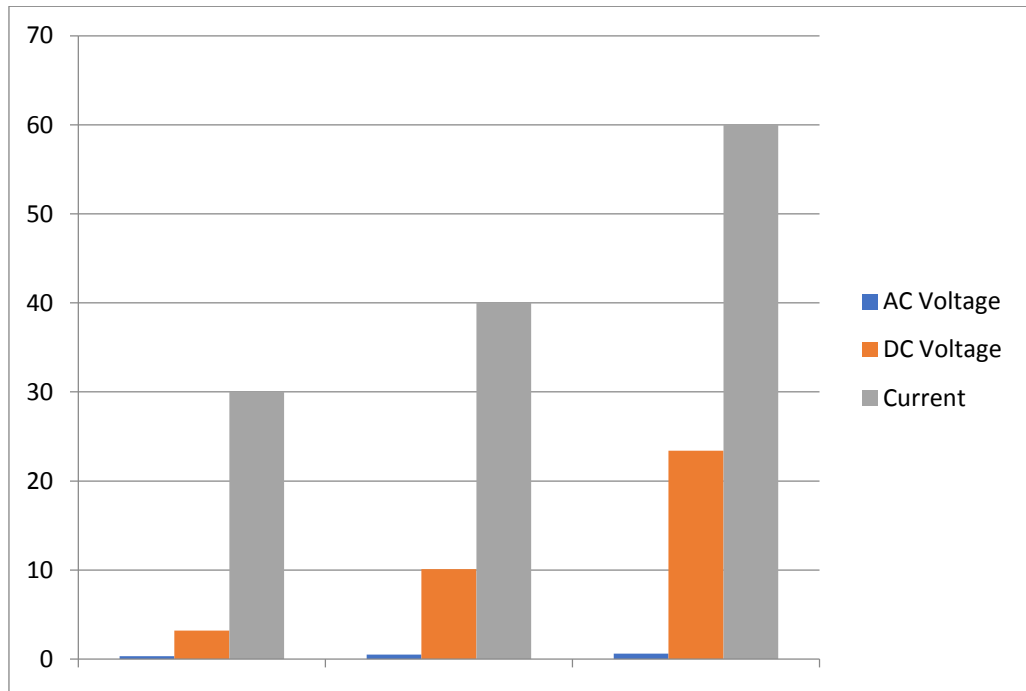


Fig 7.3:AC Voltage, DC Voltage & Current graph

CHAPTER 09

ADVANTAGES, LIMITATION & APPLICATION

9.1 ADVANTAGES

- Pollution free power generation.
- Low installation and maintenance cost.
- No manual work is required during this process.
- No fuel transportation.
- Less floor area.
- No obstruction to traffic.
- Energy available all the year.

9.2 LIMITATIONS

- There would be no generation of power when there is no vehicle passing over the system.
- There would be small jerk feel by the passenger.
- It can sustain limited load of vehicles.
- Power only generated if vehicles flow is constant and about 10-20 vehicles are required for initial movement.

9.3 APPLICATION

- Electricity generation using flip plate mechanism can used in most of the places.
- Local power generation.
- Street lightening.
- Charging station for electrical vehicles.
- On the highways.
- Sign boards on the roads.

CHAPTER 10

OUR CONTRIBUTION

TO DESIGN CAPTURE

- Designing of major components of project.
- Fabrication of the mechanical parts.
- Selection of material for making project feasible.
- Survey of major road's traffic for measuring the volume of vehicles.
- Project economics.
- All manufacturing processes like, casting of pulleys and flywheel, machining of activator plate, shafts, rack and pinion and finishing assembling of thesis parts.

- Selection of bearing. Belts, springs and shafts etc.
- Collect data of different vehicles includes weights, speeds.
- Output power calculation, and dynamics of the project.

CHAPTER 11

CONCLUSION& RECOMMANDATION

The demand for sustainable energy is increasing day by day. So, RPG proves to be a viable mechanism that can tap the wasted kinetic energy of the vehicle and in turn it can produce electrical energy. This generated energy can be used to light the street lights and also can be used to charge batteries for cars. The design of the same was carried out and the results proved that a compact RPG system can be used so as to get reasonably good amount of energy. Similarly, different constituent parts were designed and different results on the basis of design were obtained.

This project is made with pre planning, that is provides flexibility in operation. Smoother and easy handling operation by the principal of Road Power Generation. This project “Road Power Generation System using by Flip Plate Mechanism” is designed with the hope that is very much economical and helpful to our generate electricity. Thus we are complete the project successfully.

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