

Generation of Electricity from Go-Kart's Silencer Vibrations using the Combined Setup of Piezo-Electric Transducer and Dynamo Arrangement

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Abstract- In the present day scenario, Fossil fuels are on the verge of extinction and their combustion products are causing worldwide environmental issues. There is a need to develop alternative sources for power generation to overcome the previously mentioned issues from regular sources. This research emphasizes the utilization of sustainable power source assets which in turn will diminish pollution and save petroleum derivatives. Mechanical energies like vibrations, forces etc. are getting wasted when the vehicles are in dynamic condition. This form of energies can be accumulated by commissioning a special arrangement of piezoelectric transducer and dynamo arrangement.

From the past few years, the manufacturing of low power electronic gadgets has expanded quickly. With the increment in the utilization of these compact electronic gadgets, the concept of focusing sustainable energy sources in the human environment emerges new enthusiasm among everyone. This research provides detailed structuring and development of the piezo-electric, dynamo circuit and its charging system for the generation of piezo-electricity through go-kart. As there are no suspensions in a go-kart and the clearance from the ground is a maximum of two inches. This system provides energy when the go-kart is in dynamic condition and the energy is then reliably used or maintained in the capacitor bank for further prerequisites. In this way, vibrations caused in the go-kart are used for delivering power with the help of piezoelectric arrangement and dynamo. This basic idea helps to create a platform to generate electricity from huge vibrational sources which can be discovered from nature.

Key words: Piezoelectric Sensors, Mechanical energy, Electrical energy, Go-kart, Rack and Pinion mechanism.

1. INTRODUCTION

Nowadays, energy is a major concern around the world. As we all know that the natural resources will be getting depleted out one day. That is the reason; the researchers and analysts are attempting to introduce new substitute sustainable energy sources from nature that must be green and also non-hazardous for the earth. Energy harvesting is characterized as capturing moment

measures of energy from at least one of the surrounding energy sources [1]. Micro energy which is produced from natural sources is termed as Micro-energy harvesting. The energy of accumulating micro-energy is based on the conversion of mechanical vibration, stress and strain into an electrical form of energy [2].

There are many necessary gadgets, sensors, gauges, LED lights, safety applications applied in go-kart (or in any automobile) needs electricity for their respective functioning, this energy can be produced by converting the mechanical vibrations, forces and pressure energy by using various devices like piezoelectric sensor and dynamo. These energies are free, present in an ample amount and can be found in every portion of the vehicle. The whole setup of the piezoelectric sensor and dynamo comprises two power generating devices i.e. piezoelectric transducer and dynamo along with rack and pinion arrangement. This setup is being fitted between the chassis member and the exhaust of go-kart where the vibrations are present in huge quantity. In this way, the effective use of these energies like mechanical vibration and forces for power generation is being done. This research paper is based on generating electricity using the arrangement of piezoelectric material and dynamo.

2. LITERATURE REVIEW

The energy crisis is a barrier in the supply of energy resources to an economy. This research will assist to overcome the energy crisis leading to the idea of generating power utilizing by piezoelectric arrangement. The fundamental of this research is the transformation of the mechanical vibrations, forces and pressure energy into electrical energy that goes waste when the vehicle is in the dynamic condition. Since then a lot great deal of research has been done till now in this field. This research will help to develop such an arrangement, which will be able to deliver more power and can be stored for additional different uses of the automobile.

2.1 Piezoelectric Generators

Piezoelectric generators generate electricity when they are exposed to a significant amount of compression or bending caused due to an external force [4]. As a result of this property, they have numerous applications. To

generate electricity, piezoelectric materials such as Quartz, Lead zirconate titanate, barium titanate are used. These materials convert mechanical energy due to the pressure applied and vibrations to electrical energy like voltage or current. These crystalline materials can likewise deform when voltage is applied to them.

Piezoelectric Materials are being studied broadly on the grounds that they are strange materials with explicit and very fascinating properties.

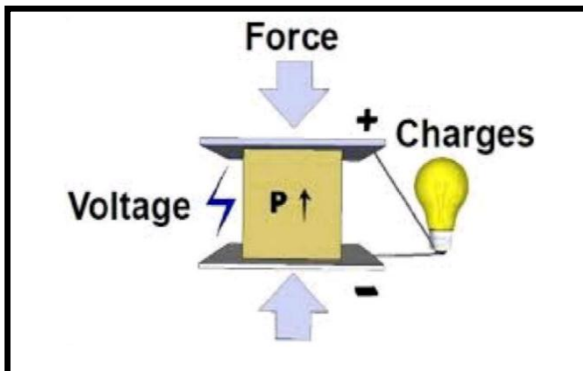


Fig. 1. Energy generation through vibration

2.2 Dynamo

A dynamo is an electrical generator that generates a direct current flow stream with the utilization of a commutator. Dynamos were the first electrical generators equipped for supplying power to the industry, and the establishment whereupon numerous other later electric-power conversion gadgets which include an electric motor, the alternator and the rotating converter [4]. Nowadays, a normal alternator dominates huge-scale power generation because it's for proficiency, reliability and cost-effectiveness. With the help of dynamo, the rotating coil of wire and magnetic field converts the mechanical rotation into a direct current flow through Faraday's law of Electromagnetic Induction [5].

2.3 Rack and Pinion Mechanism

A rack and pinion is a common type of linear actuator that constitutes a set of gears that transforms linear movement into rotary movement or vice-versa. Gear racks are utilized for the transformation of rotational movement into linear motion. A circular gear known as "the pinion" engages teeth on a linear bar characterized as "the rack"; linear movement applied to the rack makes the pinion rotate, thereby translating the linear movement of the rack into the rack movement of the pinion. Normally, gear rack and pinion are together known as "rack and pinion" [6].

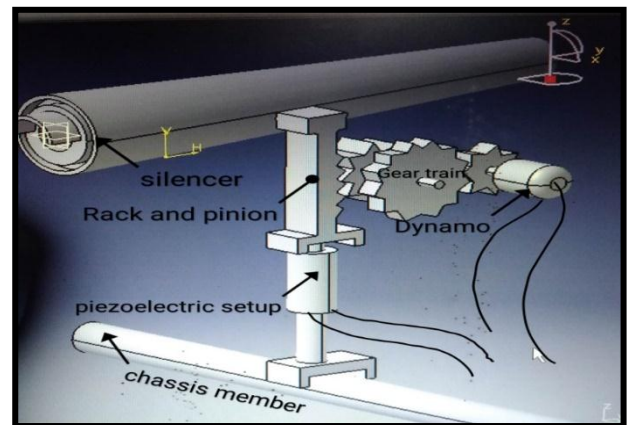


Fig. 2. General arrangement of a rack & pinion arrangement

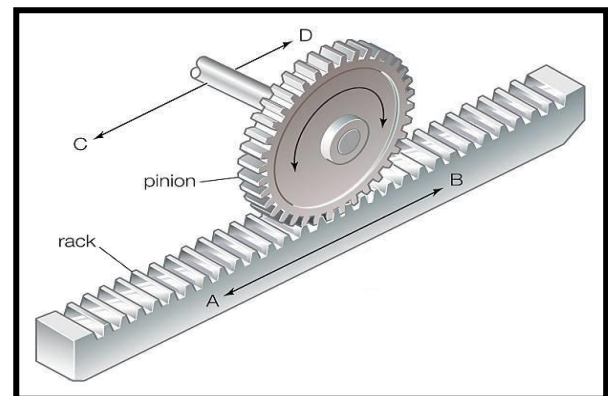


Fig. 3. Arrangement of combined setup (piezoelectric sensor, dynamo and rack and pinion) in go-kart

3. WORKING

This research explains the mechanism for producing the electricity through the vibration and forces being produced due to exhaust silencer of the go-kart. The setup comprising of piezoelectric transducer and dynamo is attached in the mentioned manner, the piezo-electric setup is connected to the rack and the rack then converts linear motion to rotary motion following the pinion. The pinion is compounded with the gear-2 which is then meshed along with the gear-3 to which the dynamo is coupled. The head of the rack is bolted to the exhaust silencer and its bottom is fitted over the upper side of the piezoelectric setup and the bottom of the setup is bolted to the chassis member of the go-kart.

When the engine is turned on with the movement of the piston, the engine will create vibrations throughout the go-kart and with the increase in speed and due to road condition intensity of vibration will be increasing gradually resulting in the exhaust silencer vibration. Hence, exhaust silencer exerts a force on the rack and rack moves downwards due to which rotation of pinion is been obtained. Henceforth, the larger gear-2 rotates and its speed of revolution enhances the speed of the smaller

gear-3 and increases its speed to obtain more intensity [7]. This speed is enough to engage the rotor of the generator (dynamo) and which results in the rotation of the rotor, the rotor which operates inside a static magnetic stator and cuts the magnetic flux around it thus producing the electricity. And simultaneously the piezoelectric pick up senses maximum vibrations coming from the rack and because of the pressure produced is then applied to the sensor and this sensor converts the vibration energy to electrical energy. The rotation of final gear is converted into electricity by the dynamo which will be stored in the battery and which can be further used for various purposes such as in the application of brake lights, dashboards, LED light, position and motion sensors used in a go-kart or any automobile etc. [7].



Fig. 4. Setup implemented on go-kart

4. ENERGY STORAGE

The collected energy can be put away in rechargeable batteries or supercapacitors, or both. The scope of items accessible is huge, going from frameworks that can begin a truck with a flat battery from cold, to sub smaller than usual gadgets working at the μV level. If an application requires an abnormal state of intensity, at that point a quick charge/release supercapacitor might be the best arrangement. On the off chance that low degrees of intensity is required to be discharged gradually over a significant lot of time, at that point battery-powered batteries are a superior best arrangement [8].

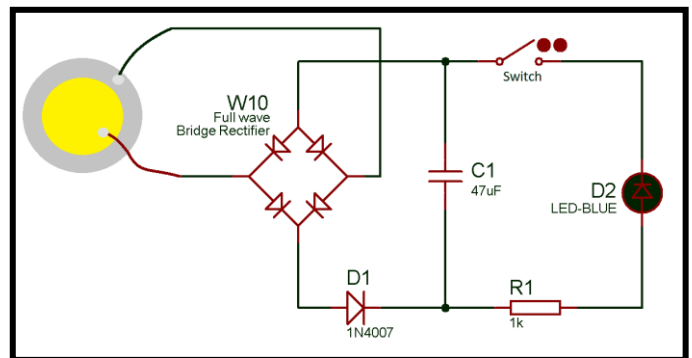


Fig. 5. Simple circuit of piezoelectric energy generation

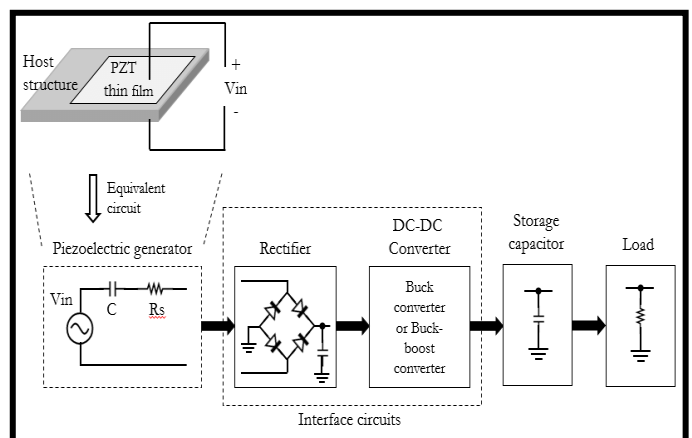


Fig. 6. Piezo-electric sensor with testing by multimeter

5. RESULTS AND DISCUSSION

The electricity generated in terms of voltage by the piezoelectric sensor and from the output of dynamo 0.20v and 0.13v respectively at the lowest speed of 150cc powered go-kart. As the speed increases the amount of electricity produces increases accordingly. The amount of energy produced would be suitable for the proper functioning of electrical devices in a go-kart, but the amount of energy required is comparatively less for the working of electrical devices in any other automobile. Hence, if there is proper research done on the piezoelectric sensors to increase its efficiency and effectivity to produce more power output will be beneficial for the research.

Table- I: Amount of voltage developed

Voltage Developed By	Obtained Voltage
Piezoelectric transducer	0.20v
Output by dynamo	0.13v

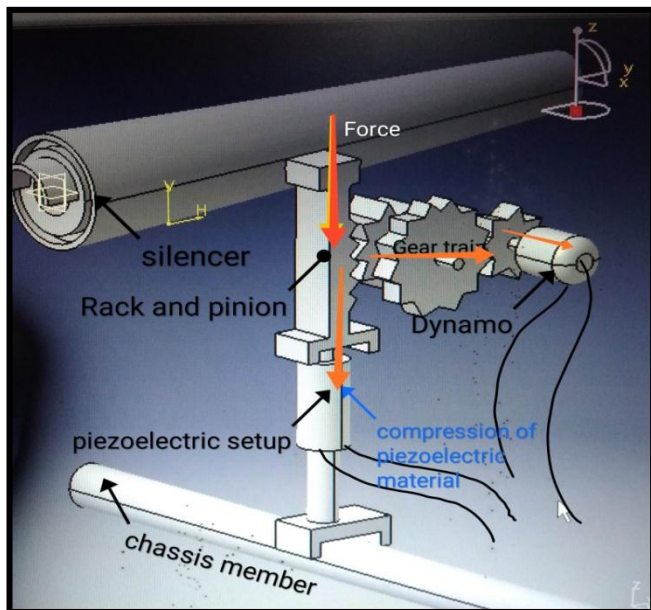


Fig. 7. Forces acting on the setup

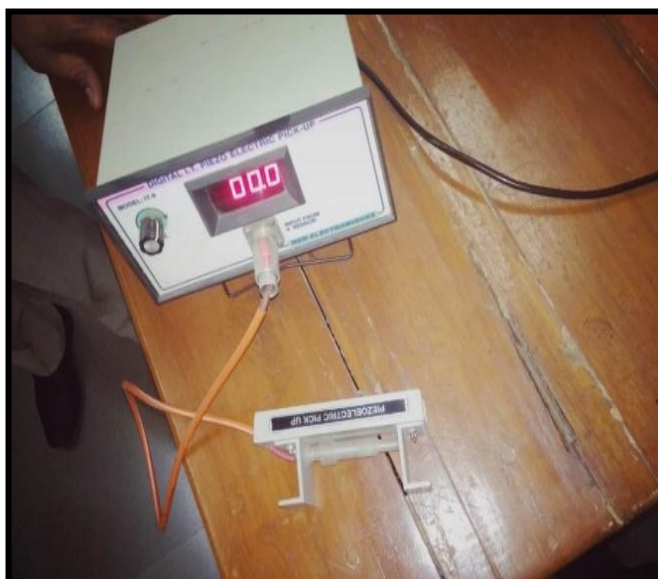


Fig. 8. Testing of piezoelectric transducer

6. CONCLUSION

By observing numerous advantages and different components it can be concluded that this is the best strategy for pollution-free power generation. Energy is a significant source of contribution to continue industrial growth and the way of residence in a particular nation can be directly identified with energy consumption. The conventional energy sources like coal, oil, uranium and so forth are depleting extremely quickly and by the turn of the century, the man should rely on non-conventional sources of energy for power generation. The research will be helpful to solve a portion of the issues where the availability of electric power is low. This research will be progressively appropriate and effective for power generation using automotive vibration. Advantages of the

electricity generation by utilizing speed breaker, for example, Pollution free power generation; Simple construction, develop innovation, and easy maintenance; No manual work is essential during age; Energy accessible throughout the year; No fuel transportation issue; No consumption of any fossil fuels which is non-renewable energy source; No external source is required for power generation.

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