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"ENERGY RECUPERATION USING PIEZOELECTRIC SUBSTANTIAL FORVEHICULAR LOCOMOTION"

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1. ABSTRACT

In the project, Energy is being harnessed from the tyres with the help of piezoelectric material. The energy dissipated by the wheels to the surrounding can be captured and transformed into electrical energy. Tyres are a good source of pulsating/alternating force which can be converted into alternating current. The tyres experience undulations and vibrations while braking as well as accelerating, vertical reaction forces while riding over bumps and potholes, hence justifying the need of a mechanism. This mechanism has vast applications and can open the door to endless innovative ideas for energy harvesting in Automobile sector and subsequent fields.

2. INTRODUCTION

With the everyday developing and growing world, there is also a growing demand for energy supplies. With the increase in demand there is an increase in concern in the depletion of resources used to generate energy the traditional way. Society is developing new alternative non-conventional methods which are gaining much popularity in today's world. Many popular and successful methods are the Solar cells, Wind energy, hydroelectric energy, geothermal, biogas plants. With the ever growing Automotive industry and introduction of HEV's and EV's, a lot of energy is required to mobilize them. There is a need to cater this energy. Piezoelectric material and effect play a major role in solving this problem. The vibrations and undulations from the vehicular motion can be converted into electrical energy using piezoelectric effect. Tyres of the vehicle are subjected to normal and shear loads, this load can be used as the source of mechanical stress for the piezoelectric material. This project is based on a case study on a tyre of Tata Nexon EV currently running on road.

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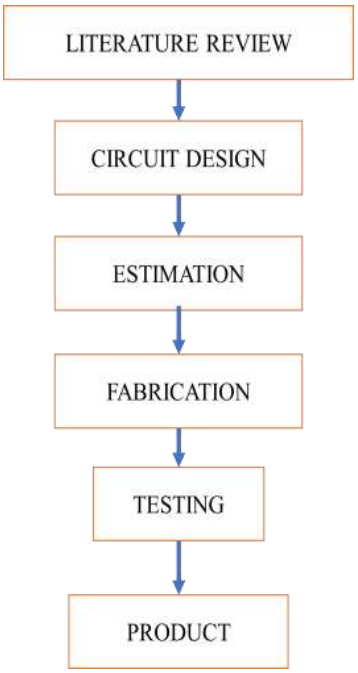
3. METHODOLOGY :



CIRCUIT DESIGN:

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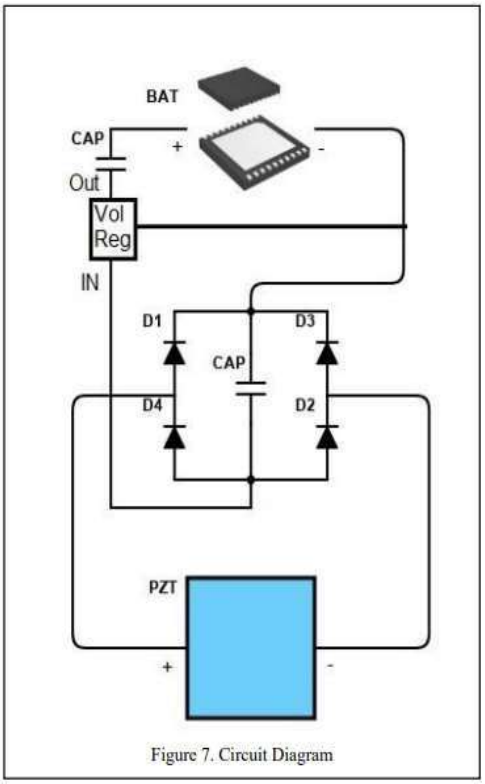

Figure 7. Circuit Diagram

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The PZT units are connected in parallel as current obtained is more than that of series connection. The output from the PZT unit is AC, which cannot be used to charge the battery. Therefore, a Full Wave Rectifier is used to convert AC to DC. The Rectifier consists of 4 or more diodes arranged in the bridge circuit configuration. The bridge rectifier consists of 4 diodes D1, D2, D3, and D4 in which the AC input of PZT is supplied across two terminals while the DC output is stored in the battery through the remaining two terminals. The AC consists of two cycles: 1. Positive half cycle: During this cycle diodes D1and D2 are in forward bias while D3 and D4 are in reverse bias. The current flows through diode D1, then through the load, and finally completing the circuit by passing through D2. 2. Negative half cycle: During this cycle diodes D3and D4 are in forward bias while D1 and D2 are in reverse bias. The current flows through diode D3, then through the load, and finally completing the circuit by passing through D4. During both cycles, the current passes through the load. Henceconverting both half cycles of input AC to pulsating DC. The DC output which we get consists of some ripples. To reduce these ripples, a filter is used. A capacitor is used as a filter which is connected across the battery. For getting constant voltage, a voltage regulatoris used, which is connected across the output of the bridge rectifier and load as shown in the figure.

FABRICATION:

- Packaging of PZT
- Orientation of PZT modules
- There are different layers in tyres and the function of each layer is different:
- Inner liner
- Ply(above the inner layer)
- Bead and Apex
- Breaker
- Tread
- Orientation of Piezo-electric
- Assemblage

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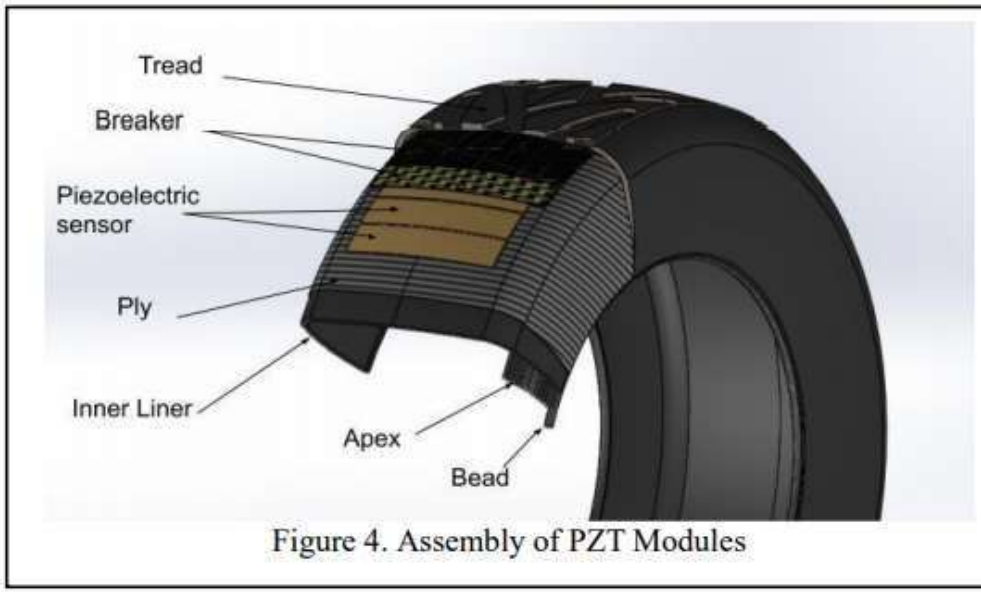

Figure 4. Assembly of PZT Modules

- **ORIENTATION OF PIEZO-ELECTRIC:**

Unit 1: During the manufacturing process the first layer will be an inner liner followed by a layer of ply with the bead and the apex on the sides. After these layers are placed on the machine, the layer of piezoelectric sensor would be placed on top of the ply. Before applying the side wall to the unit, the piezoelectric wiring is taken out for later connection. The side wall's layer is placed above the wiring. Using these arrangements, the wire connection is concealed within the tyre.

Unit 2: the bottom layer comprises of two layers of breaker, followed by cap ply and the layer of tread.

- **ASSEMBLAGE:**

Unit 2 is placed over unit 1 which are glued together by applying air pressure. Then the assembly is sent for vulcanization. Vulcanization is a process in which the hot steam is passed through the membrane which is in contact with the inner side of the tyre. The outer side of the tyre is in contact with the mold which is also known as curing mold. In this process the tire gets its marking and tread pattern. Because of the temperature, all layers inside of the tire become one. The temperature range is between 170 -200 degree C and at pressure of 22 bars for around 10 min.

4. RESULTS AND DISCUSSION:

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- The batteries in an electric vehicle are self-charged as the car is in motion, due to thepower generated by the tier.
- To increase the range of electric vehicles.

5. CONCLUSION:

The study proves that the mechanism is not efficient enough to generate energy required to fully energizing any vehicle, but it can be used to increase the range of the same. This mechanism has vast applications which can revolutionize the future of electric vehicles. The study also justifies the need of advancements in the material selection for the piezoelectric sensors.

FUTURE SCOPE:

- The mechanism can be installed and various other components of an automobile, for ex: suspension system and harness energy. Piezoelectric plate can be fitted in between the leavesof a leaf suspension and also in between the gaps of a damper spring to generate electricity.
- Advanced substitutes for the conventional piezoelectric material have to be invented whichare more flexible, cheaper and highly efficient.

6. REFERENCES:

[1] A. Dinesh Kumar, Dr. S. Sumathi, RENEWABLE ENERGY SOURCE PIEZOELECTRIC HARVESTERS IN CAR TYRES 2015 Online International conference on Green Engineering and Technologies (IC-GET 2015).
[2] A. Sanjay. (2019). PIEZO ELECTRIC GENERATOR IN CAR TYRES. Sri Kumaraguru college of technology.
[3] N. Burham, M. N. A. Malek, A. A. Aziz, N. I. Shuhaimi, A. M. Markom, faculty of electrical engineering university of technology MARA (UiTM) Development of piezoelectric energy harvesting via vehicle movements.
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International Journal For Technological Research In Engineering Volume 5, Issue 11, July- 2018 ISSN (Online): 2347 – 471
[5] Electro-ceramics products and material specification Harris Technology to connect, inform and protect www.Harris.com

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