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The mechanism parts of mechanical motion rectifier to produce energy from third pedal in automotive

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Abstract: Energy harvesting architectures, such as wind turbines and solar panels, have become a necessity as renewable energy sources have grown in popularity. The most promising source of electric energy appears to be electromechanical energy harvesting, as it generates significant amounts of electricity that can be utilized in numerous ways. This research supports and supplements the automotive, regardless of how much and how effectively power is generated. Essentially, when the driver touches the throttle or brake pedal, the energy-harvesting pedal receives motion from them through a mechanical connection rod. Considering its utility in charging electric cars, it is considered one of the most useful sources of electricity.

1 Introduction

The harvesting of energy refers to the capture of electricity from the environment and using it for energy production. There are several methods of harvesting energy, including piezoelectricity, thermoelectricity, and electromagnetic energy [1]. There are numerous ways to utilize electromagnetic energy harvesting, which has the potential to provide a significant amount of electricity. Research on roads has been conducted by a few independent companies and researchers. The first, we must understand the design of HPE.

2 Conceptualization of design

Pedal energy harvesting refers to capturing the potential and kinetic energy produced by the driver's foot when the pedal is pressed. In Figure 1. the concept development stages are illustrated.

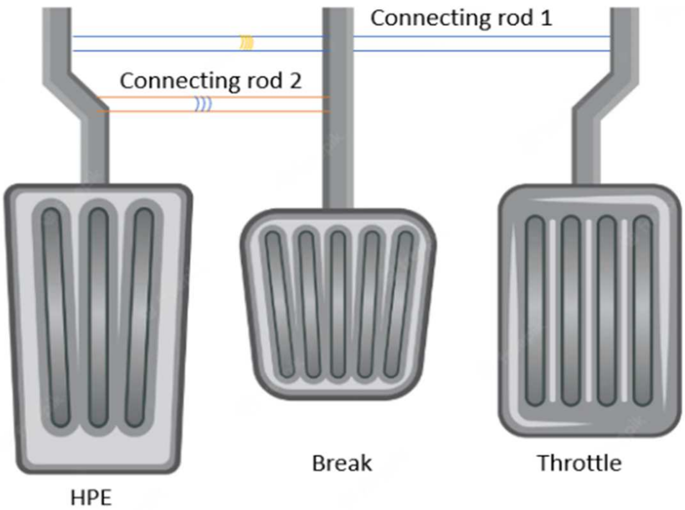

Figure 1 Concept development stages for HPE

Pedal energy harvesters (HPE) capture the kinetic and potential energy that is emitted by contact between the feet of the driver and the pedal [2]. The main components for the pedal energy harvester are included in Figure 2.

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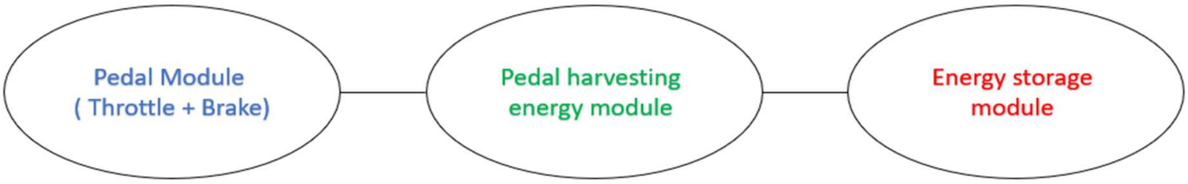

Figure 2 The main components for the harvester pedal energy

In order to understand each model, we must first learn about its characteristics and features.

1. Pedal (throttle + break) module: As mentioned previously, a connecting rod connects the throttle and brake pedals to the HPE module [3].

1.1. Connecting plate: it is made from stainless steel type 440 because the reason for this is so that the load can withstand shocks and be carried effectively. It delivers the load from the driver to the harvesting module.

1.2. Springs and Bearings: there are springs connected to the pedal from the bottom and linear bearings connected with shafts, as shown in Figure 3.

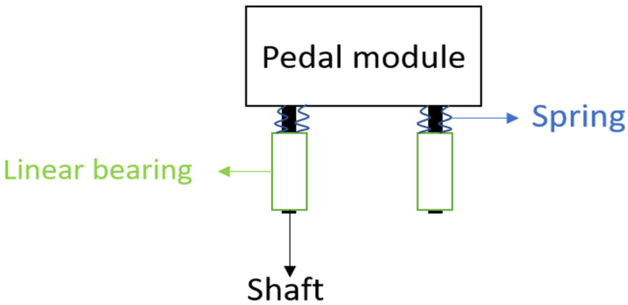

Figure 3 A schematic of the (throttle & brake) module

How do we choose the springs?

As part of the design process for pedal energy harvesters, spring selection plays a vital role since it determines the energy harvester's performance and load ability. In order for the spring to be chosen correctly, it is important to note that the time required for it to rebound to its natural or original position should be roughly one-quarter of the time it takes for one complete cycle of oscillation, which corresponds to the natural frequency of the system. Another important consideration in spring selection is the time between each pedal press and the next. This time interval, also known as the pedal cadence, should be taken into account when selecting the spring, as it affects the energy storage and release characteristics of the system. The spring must be able to store and release energy quickly enough to keep up with the pedal cadence, while also providing sufficient energy storage capacity to meet the system's overall requirements.

2. Pedal harvesting energy module: it contains the following.

2.1 Pinion gear (1 and 2) and rack system: it acts to convert linear motion into rotational motion. as seen in Figure 4.1 and Figure 4.2. The specification for its L=340 m, 2F, LAM, DDF= 9-14.

Figure 4.1 Rack system

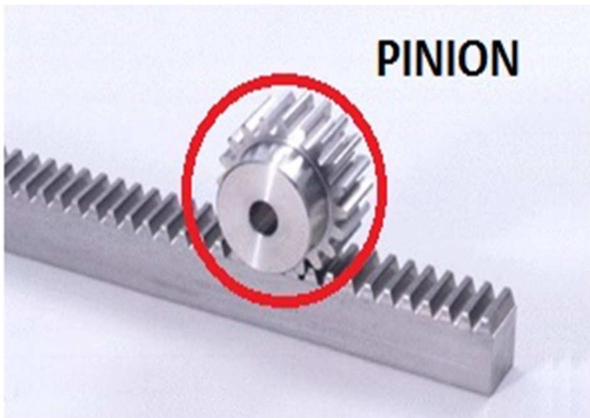

Figure 4.2 Normal pinion gear 1 and 2

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The specification for the toothed wheel is Z = 25 M2 LR = 20 IF DF = 25 CLLR = 8.

2.2. Gearbox (Figure 5): A harvesting unit's gearbox plays an important role. it is used. Because normal pinion gear speeds are insufficient to drive the motor and achieve its rated speed [4]. The planetary gearbox made from Nanotec Company.

Figure 5 Gearbox

2.3. Guide & bearing: it forms the part of the connection between the connecting rod and rack system by bearing pin which can see in Figure 6.1. There are two different types of bearings, linear bearing guide FRN 32EI and FRNR 32 EI as shown in Figure 6.2 and Figure 6.3 [5].

Figure 6.1 Guide, FS32TT, L=460mm, 9F, DF9

Figure 6.2 Bearing FRN and bearing FRNR

2.4. Support: The purpose of shaft supports is to clamp and place parts that are used in linear motion applications. There is a tendency for the support blocks to deflect between the supports when the weight is somewhat light. Support blocks are most likely to be used for applications with a low load in order to minimize deflection between the supports. the type we used is UCPA 206 as in Figure 7.

Figure 7 Support UCPA 206 of shaft

2.5. Coupling (Figure 8): it is a mechanical device that connects two rotating components, such as shafts or gears, while providing flexibility to accommodate minor misalignments or movements [6]. This flexibility enables the two components to remain connected and transmit power, even if they are not perfectly aligned or if there is some movement or vibration in the system.

Figure 8 Coupling of the shaft

3. Energy storage module: It is consisting of a generator motor that there are no brushes in brushless DC motors (Figure 9), so friction cannot occur. As a result, brushless motors are more efficient. Additionally, BLDC motors can be used as generators, so the prototype uses a three-phase, single-shaft BLDC motor. Also, this model has an electrical load.

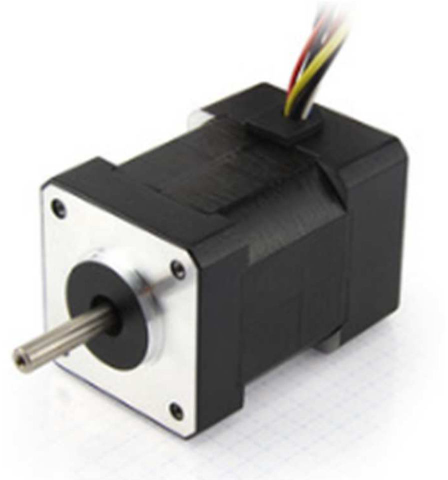

Figure 9 Brushless DC motor NEMA 17

3 Mechanism of motion

For all three modules, we can collect the previous parts and draw them as follows (Figure 10, Figure 11).

From the previous schematic, it can be seen that the device responsible for converting energy from linear motion to rotational motion is known as a mechanical motion rectifier (MMR). The MMR accomplishes this by converting the linear motion from racks into rotational motion by interlocking the pinions gear 1 and 2 in a system [7]. With the help of a connector rod, the rack is attached to the pedal module. As the driver presses the pedal module vertically, the rack will move, the pinion gear will rotate as well as the shaft will spin also. When the shaft rotates, causing the gearbox spins, and thus the DC motor thereby rotates which then generates electric power. A gearbox will be used to speed up the power generation and to improve the efficiency of the conversion since the linear rotation of the rack cannot achieve high rotational speeds. These generated energies are stored in a battery, which is used to recharge the vehicle later.

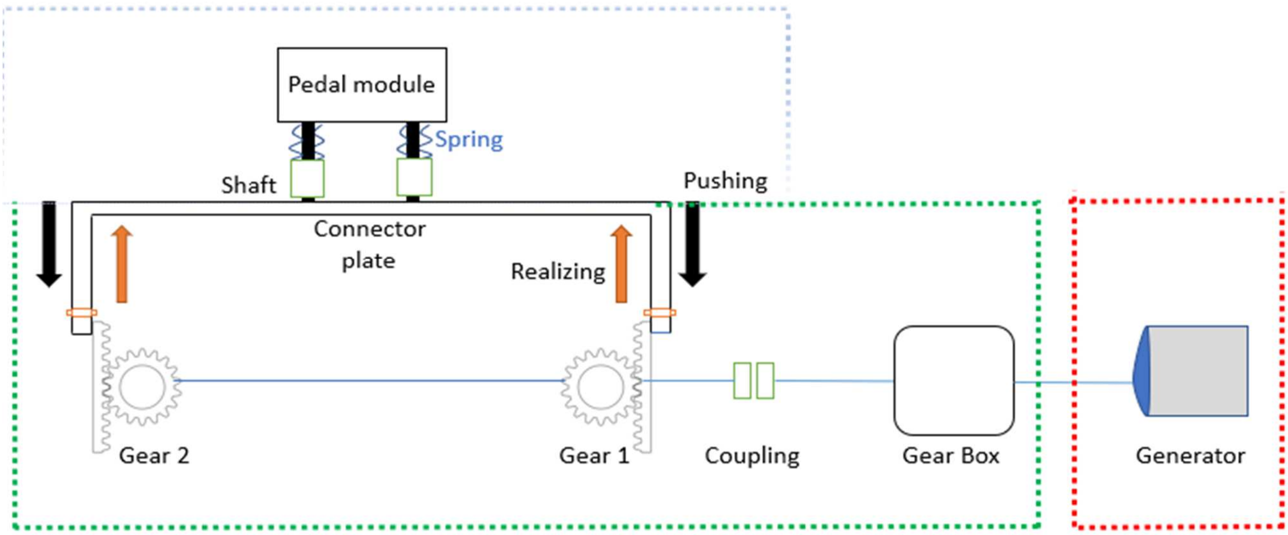

Figure 10 A schematic of the mechanical motion transformation for the harvester pedal energy (HPE)

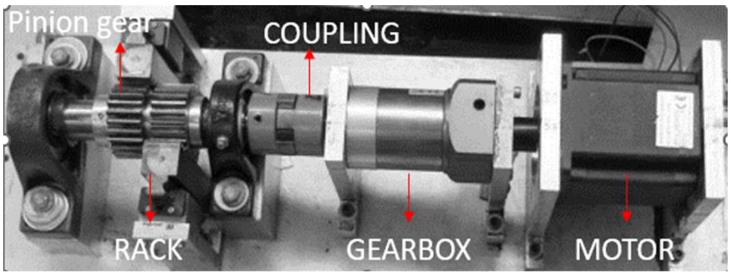

Figure 11 Mechanical motion transformation of the harvester pedal energy (HPE)

4 Conclusions

It was found that whatever the amount and effectiveness of power generated, this mechanism of motion for pedal harvester energy supports the automotive industry by supplying electricity much like pressing this pedal and then converting the motion to rotate the DC motor by MMR. The prototype represents the forerunner of future concepts of similar PHE and creates other ideas for researchers.

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