Self-Charging Automobiles

N. Muneer
B. Tech Student
Department of Mechanical Engineering
A P J Abdul Kalam Technological University, Kerala, India

Abstract— The world is trying to go fossil free. The hazardous effect witness by this world because of its overdependence on fossil fuels made it rethink. The humans are pursuing way to terraform our own planet rather than going after any alien planets. The only sustainable way to achieve this remarkable milestone is to eliminate or to an extent reduce the use of fossil fuels. However, our transportation network come to a halt. This have only one solution if we use automobiles running on electricity. Our IC engines should be replaced by the electric motors. The main challenge lies in the storage of electricity in the vehicles. In this paper, we try to address this problem by synchronizing all the possible methods to charge an automobile while in motion.

Keywords: Self-Charging, Solar Roofing, Regenerative Braking System, Piezoelectric Wheels

I. INTRODUCTION

The threats of global warming, greenhouse effect and other drastic changes in climate have been haunting our civilization over the past two decades. If any solution exists to fight these is to change our fossil fuel consumption. It can be achieved by developing newer fuel with carbon free emissions or to go electric.

The electric vehicles are always casted aside due to there incapability to dependable. The main reason for it is that they can't store enough charge for a long run. We need to connect them to a socket regularly to keep going. It can be avoided if our vehicles get charged automatically while running. Each time when we set to travel, our batteries will be fully charged without even connecting to a power socket. It can be achieved if we introduce different ways to charge the automobile battery while the vehicle is in motion.

II. METHODS TO SELF-CHARGE

The different methods involve the use of all possible ways to eliminate the use of fossil fuels and promote self-charging. So that after every ride, the automobile is ready for another without connecting to the external power source. The different ways to automatically charge an automobile include - placing a wind turbine module in the vehicle, regenerative braking system, piezoelectric wheels, solar roofing. Solar panel paved car roof can be employed for capturing the solar energy. Regenerative braking system can specifically provide a considerable amount of energy. The piezo electric wheels having piezo materials can convert mechanical stress in the wheels to useful form of energy. The wind turbine module to harness the energy from wind stream due to the movement of vehicle.

A. Piezoelectric Wheels

Piezoelectric material are the smart materials which converts mechanical stress or strain into electric potential. The piezoelectric material in a piezoelectric system has different mode of operation. The modes are characterized by piezoelectric strain d_{ij}, mechanical strain to electric voltage. The subscript 'i' denotes the direction of electrical voltage output and 'j' denotes the direction of action of mechanical stress. There are predominantly two constant d_{33} and d_{31} with poling direction being the 3-axis.[1]

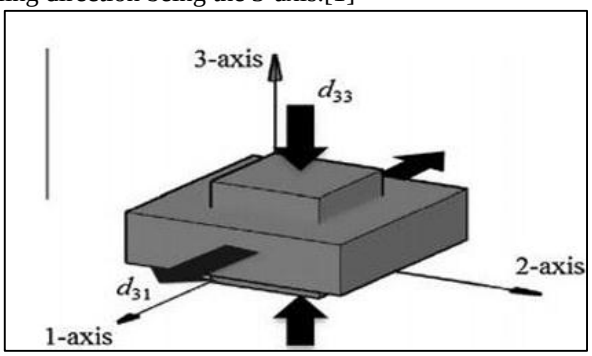

Fig. 1: operation modes and reference axis

There are some implementations over the globe based on this concept. The concept has been successfully implemented in the Tokyo Station, Japan[2] where the ticket gates are floored with piezoelectric materials.

Fig. 2: piezoelectric materials used at ticket gates in Japan

In case of piezoelectric wheels, a piezoelectric array is mounted inside a pneumatic tire of an automobile and flexed or distorted during each revolution of the tire. Because of the inherent nature of piezoelectric devices, distortion creates an electron flow. The outputs of the piezoelectric devices are connected to an electric circuit to transfer the high voltage, low amperage electricity that is compatible with the electrical system of motor vehicles. Piezoelectric units are bonded to the inner liners of the tires. As the wheel rotate, the tires repeatedly distort and slacken as they interact with the road. This causes the piezoelectric units to produce a periodic voltage with a speed dependent frequency. Each piezoelectric vehicle tire is equipped with an array of highly bendable PZT (lead (Pb), Zirconia (Zr), Titanate (Ti)) benders converting most of the inner surface. The output, due to deformation of tires, is an AC waveform, which can be converted into a DC signal by a rectifier before it can be stored in capacitor. Each row of benders, running across the width of tire is taken as one generator and is rectified separately with all PZT lines

connected in parallel. At any given point, two or three row generate power.

Fig. 3: Piezoelectric wheel

B. Solar Roofing

The term "solar roofing" means to cover the cars roof with solar panel. So that, it produces enough power to charge the batteries when the car is parked. It also generates electricity while on the movie, powering equipment such as air conditioning etc to reduce the load on the batteries. Solar roofing can accomplish this through photovoltaic cells (PVC). PVCs are the components in solar panelling that convert the solar energy into electricity. They are made up of semiconductors, usually made of silicon, that absorb the light. The sunlight then frees the electrons in the semiconductors, creating a flow of electrons. Many automobile manufactures have already implemented the solar roofing in their vehicles.

Fig. 4: Solar sunroof in Audi A8

C. Regenerative Braking System

It involves the storage of kinetic energy as electrical energy in batteries and capacitors or as mechanical energy of a flywheel having large moment of inertia. There are two types of regenerative system - motor based regenerative system and flywheel based regenerative system.[3] In motor based, the drive shaft of vehicle is connected to a motor. When power is on to motor, it starts rotating and in turn drive the shaft of vehicle. When brakes are applied, the driver presses the brake pedal which cuts off the current supply to motor. Now motor is no longer providing torque to driving shaft, instead the inertial kinetic energy and momentum of vehicle drives the motor, electric motor now starts acting as a generator resisting the inertia of rotational motion of vehicle to slow down the vehicle besides producing electricity. In flywheel based, there is a flywheel having a large moment of inertia, so that it requires a large torque for rotational acceleration. There is an arrangement of flywheel for engagement and disengagement in connection with the drive shaft. When the driver stops the vehicle, the flywheel is engaged with the drive shaft with the help of gears. When flywheel gets actuated power is shared among the driving shaft and flywheel, flywheel having a large moment of inertia absorbs the power from engine in form of rotational kinetic energy and brings the vehicle to halt. This rotational kinetic energy can be used further to accelerate the vehicle.

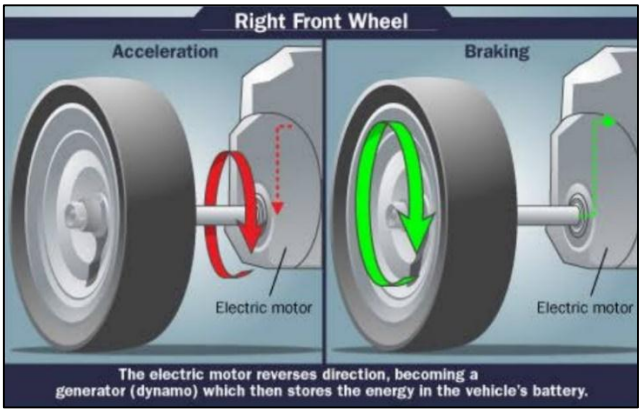

Fig. 5: Regenerative brakes

D. Wind Turbine Module

When a vehicle moves it experiences wind resistance which is classified in two different forms- frictional drag and form drag. Frictional drag arises due to viscosity of air and form drag arises due to variation of air pressure in front and rear side of the vehicle [4]. Wind turbines are used in submarines to charge the batteries when they remained static and float in water. A model for wind turbine modules to be placed in the vehicles was developed by S.M.Ferdous, Walid Bin Khaled, Benozir Ahmed, Sayedous Salechin, Enaiyat Ghani from Islamic University of Technology, Bangladesh. The output power from a wind turbine is given by [5]

$$P_T = 0.5\, C_P\, \rho\, Q\, v^2$$

Where,

P_T = Power output from the turbine in watt.

C_P = Power co-efficient, assuming 0.4 for the design.

"ρ" is air density

Q = air flow in m^3/s

v = air velocity in m^3/s

The figure below shows the proposed model. The diameter of the rotary engine is a hundred and twenty cm that is placed at the rear aspect of the vehicle. All dimensions in the diagram are in Centimeters.

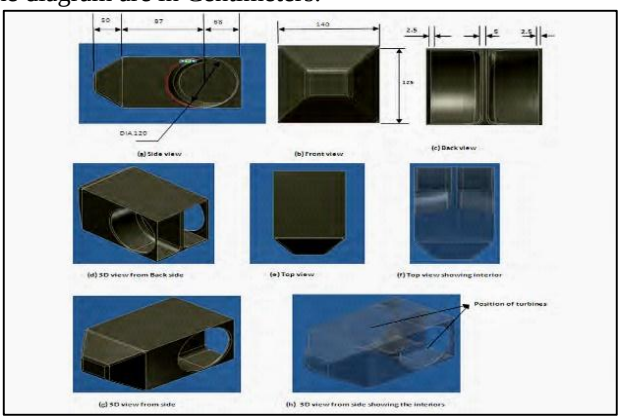

Fig. 6: 3D and isometric view of the model.[6]

III. CONCLUSIONS

With increase in popularity of non-conventional energy sources all over the world, the self- charging automobiles make its way towards fossil free fuel goals. Better storage and intelligent synchronization of all power generation sources are required for the success of this project. Also, major automobile manufactures should promote and invest on this technology. If efficient and proper co-ordination can be provided, this could bring a new revolution in the field of automobile industry.

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