HYBRID ELECTRIC VEHICLE TECHNOLOGY: A REVIEW

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Abstract: An outline of crossover electric vehicle innovation is administered. This sums up the components that require the advancement of half and half electric vehicles, characterizations of mixture electric vehicles dependent on the course of action of the interior ignition motor and the electric engine for footing. The kinds of batteries required and the utilization of force electronic converters for successful force handling and use in half and half electric vehicle drive is covered. Likewise, the qualities and shortcomings of different sorts of particular electrical engines for foothold drive in mixture electric vehicles are treat.

Keywords- *Fossil Fuel, Fuel Cell, Parallel Hybrid Electric Vehicles, Series Hybrid Electric Vehicle*

I. INTRODUCTION

Customary vehicles work on the rule of inner ignition motor (ICE) that sudden spikes in demand for petroleum products (gas or diesel) from oil stores that are a long period of time old. ICE vehicles radiate carbon dioxide, hydrocarbon, sulfur oxides, carbon monoxide and hydrocarbon through their tailpipes. These gases bring about an unnatural weather change through greenhouse gas impacts and contamination impacts which are hurtful to both climate and lives. Additionally, the costs of petroleum derivatives continue to rise cosmically. There is a developing logical agreement that expanding levels of ozone harming substance emanations are changing the world's environment. Additionally, oil costs keep on skying rocket while harder guidelines and strategies on allowed exhaust gases are being established in significant urban communities of the world. These and some other related issues are convincing vehicle makers to concoct eco-friendly vehicles. These kinds of vehicles are known as half and half electric vehicles. For seemingly forever electric (battery) vehicles have been in presence. They give extremely low acoustic commotion and zero discharges in their tailpipes. Despite the fact that they once contended well with the profoundly wasteful inward ignition motor vehicles, the last acquired high ground due to the helpless battery limit which made the driving scope of electric vehicles short prior to re-energizing. Additionally, the sharp decline in oil value following the 1973 Center East emergency prompted large scale manufacturing of ICE vehicles. This at last prompted the vanishing of electric vehicle from the market.

Likewise Cross breed as it influences vehicles could be as far as the fuel utilized in the inside burning motor of vehicles (fuel hybridization) or the mix of propulsive force from an interior ignition motor with that delivered by electric energy put away in batteries (drive – train hybridization).The last which is otherwise called electric – inward burning crossover. Notwithstanding vehicles that utilization at least two unique gadgets for making drive power, a few vehicles additionally utilize unmistakable energy input types or energizes. For instance, adaptable – fuel vehicles can utilize a combination of gas and petroleum gas. A few vehicles also have been adjusted to utilize another fuel source if accessible. For example, a few vehicles that sudden spike in demand for propane and diesels are altered to run on squander vegetable oil.

II. LITRATURE REVIEW

2.1 ALTERNATIVE FUELS

Utilization of elective powers is a method of diminishing the adverse consequences of traditional vehicles' tailpipe emanations. The elective fills are primarily viewed as those from inexhaustible sources like ethanol and methanol

from yields or cellulose and biomass from decay of natural material. Elective fills like methanol from petroleum gas or gasoil are of non-renewable energy source beginning; however have lower outflows than gas and diesel.

2.2 Ethanol

Ethanol is delivered through aging of sugar, which can be removed from yields or cellulose. All fuel controlled traveler vehicles can with no specialized changes be failed with 10-15% of ethanol. This is additionally workable for diesel motors after some minor changes. The benefits of utilizing ethanol are basically decrease in the discharge of unsafe exhaust gases, for example, diminished carbon dioxide, nitrogen dioxide and residue particles.

2.3 Methanol

This is mainly produced from fossil fuels (natural gas), even though it is also possible to produce methanol from biomass. The use of methanol also yields reduced emissions.

2.4 Biogas

Biogas is produced from organic rest products and from cultivated biogas. It is today considered to be the bio-fuel with the least harmful impacts on the environment. The gas consists of methane gas, carbon dioxide and water. The methane gas can be used as fuel in vehicle engines.

2.5 Natural Gas

Natural gas is a fossil fuel with main methane as the main contaminant. The emissions of carbon dioxide from the use of natural gas is 15-20% lower than by using gasoline. Engines using natural gas have mainly low emissions of particles and hydrocarbons.

2.6 Gasol

Gasol is basically a fossil fuel. The gas is quite relatively cheap and gives low exhaust emissions compared with gasoline and diesel. F. Hydrogen Gas (Fuel Cell) A fuel cell is an electrochemical energy conversion device. It produces power, water and warmth when hydrogen fuel and oxygen from the air are utilized. Water is the lone outflow when hydrogen is utilized. In an auto power device, hydrogen and oxygen go through a generally cool, electrochemical response that straightforwardly creates electrical energy. This electrical energy is taken care of into engine to control the wheels of the vehicle. The issue with this kind of fuel is that hydrogen isn't discovered normally and as such must be delivered. It additionally must be put away. Additionally, there is the chance of blast that may happen should hydrogen release and get in contact with air (take for example during car crash). Be that as it may, hydrogen gas utilized as power modules is viewed as an ideal energy transporter for the future [1]. As of now numerous in the auto business have been investigating the utilization of methanol, ethanol or gas as a fuel and transforming it on – board into hydrogen for the energy unit. The reformer is the fuel processor that separates a hydrocarbon, for example, methanol into hydrogen and some other by – item. The pith of this interaction is the general wellbeing of dealing with hydrocarbon fuel contrasted with hydrogen gas which is hard to store and deliver [1]. Kinds of energy unit accessible are Basic Power module (AFC), Proton Trade Film (PEM), Direct Methanol Energy component (DMFC), Phosphoric Corrosive Power module (PAFC), Liquid Carbonate Power device (MCFC) and Strong Oxide Power module (SOFC).

III. BATTERIES

Batteries are convenient wellsprings of electrical energy which is changed over to mechanical energy in the electric engine for impetus. There are numerous sorts of batteries in presence for half breed electric vehicle application. They are Lead Corrosive, Nickel Iron, Nickel Cadmium, Nickel Metal Hydride, Lithium Polymer, Lithium Iron, Sodium Sulfur and Sodium Metal Chloride. Instances of metal air battery which are precisely refueled are: Aluminum – Air and Zinc – Air [1]. Battery Execution Models are Explicit Energy, Energy Thickness, Explicit Force, Ordinary Voltages, Amp Hour Effectiveness, Energy Proficiency, Business Accessibility, Cost, Working Temperature, Self – Release Rates, Number of Life Cycles and Re-energize Rates. The fashioner additionally has to know how energy accessibility shifts concerning surrounding temperature, charge and release rates, batterymath, ideal temperature, charging strategies and cooling needs.

3.1 Electric/Internal Combustion Engine hybrid

This includes essentially the blend of two force sources, an interior burning motor and an electrical machine [2]. The electrical machine is intended to deal with transient force varieties and assists the motor with working all the more continually to such an extent that higher proficiency and lower tailpipe discharges can be accomplished. There are numerous approaches to make an electric – inner ignition half and half. The assortment of electric – ICE plans can be separated by how the electric and ignition parts of the force train interface, at what times each bit is activity and what percent of the force is given by every crossover segment. Two significant classifications are arrangement cross breeds and equal half and halves [4, 5].

3.1.1 Series Hybrid Electric Vehicles

In an arrangement crossover vehicle, the inward burning motor isn't straightforwardly associated with the drive train by any means; rather it controls an electrical generator all things being equal. Separate little electric engines (in – wheel engine) introduced at each wheel are included in some model and idea vehicles. This permits the chance of effectively controlling the force conveyed to each wheel, and subsequently improves on footing control, all wheel drive and comparative highlights. The upside of this kind of mixture is the adaptability managed by the absence of a mechanical connection between the interior burning motor and the wheels. A shortcoming of an arrangement crossover framework is that arrangement halfand halvesrequire separate engine and generator parcels which can be consolidated in some equal mixture motors; the joined productivity of the engine and generator will be lower than that of a customary transmission along these lines balancing the effectiveness acquires that may somehow be figured it out. In any case, arrangement crossovers are the most effective in driving cycles that fuse numerous stops and starts, for example, for conveying vehicles, metropolitantransports or unpredictable city driving.

3.1.2 Parallel Hybrid Electric Vehicles

Equal half and half frameworks associate both the electrical and inner burning frameworks to the mechanical transmission. They can be sub – ordered on the foundations of the proportion of commitment to the thought process force of the distinctive segment or bit. Sometimes the inward burning motor is the prevailing part and is utilized to supply power basically with the battery providing power just when a lift is required. Others can run with simply the electric framework working alone. Most plans join an enormous electrical generator and an engine into one unit regularly arranged between the inner ignition motor and the transmission supplanting both the traditional starter engine and the alternator. A huge battery pack is required giving a higher voltage than the ordinary car 12V. Extras, for example, power guiding and cooling are controlled by electric engines, with the goal that they keep on working when the inward burning motor is halted. This offers an extra proficiency gains by tweaking electrical force conveyed to these frameworks instead of having them run straightforwardly from the motor at a speed which

IV. DEGREE OF HYBRIDIZATION

4.1 Full Hybrid Electric Vehicles

A full hybrid vehicle is the one that can run on just the engine, just the batteries or a combination of both. The Prius and Escape Hybrids are examples of this because both cars can be moved forward on battery alone. A large, high – capacity battery pack is needed for battery – only operation. These vehicles have a split power path that allows more flexibility in the drive train. To balance the forces from each portion, the vehicles use a differential – style linkage between the engine and the motor connected to the head end of the transmission.

4.2 Assist Hybrid Electric Vehicles

This type of hybrids use the engine for primary power, with a torque – boosting electric motor connected to the conventional power train. The electric motor is essentially a very large motor which operates not only when the engine needs to be turned over, but also when the driver steps throttle pedal and require extra power. Assist hybrids differ fundamentally from full hybrids in that they cannot run on electric power alone. However since the amount of power needed is very small, the size of the battery system is reduced.

4.3 Mild Hybrid Electric Vehicles

These are conventional vehicles with oversized starter motors; allowing the engine to be turned off whenever the car is coasting, braking or stopped, yet restart quickly and cleanly. Accessories can continue to run on electrical power while the engine is off, and the motor is used for regenerative braking to recapture energy. The motor is used to run up the engine to operating speed before injecting any fuel. Many people do not consider these to be hybrids at all, and they do not achieve the fuel economy of full hybrid models.

V. OTHER TYPES OF HYBRID ELECTRIC VEHICLES

5.1 Plug-In Hybrid Electric Vehicle (PHEV)

This is a full hybrid, able to run in electric – only mode with larger batteries and the ability to recharge from the electric power grid. They are also called gas optional or griddable hybrids. They run partly on electricity generated at local power plants, which can lessen the nation's reliance on oil while offering utilities a robust market for their off – peak power [3]. Their main advantage is that they can be gasoline – independent for daily commuting. It also has the extended range of electric hybrid for long trips. They can also be multi – fuel with the electric power supplemented by diesel or hydrogen [6].

5.2 In-Wheel Motor Hybrid Electric Vehicles

The newest innovation in hybrid electric vehicle is the in – wheel motor hybrid electric vehicles. In this hybrid category, separate small electric motors (in – wheel motor) is installed at each wheel. The in – wheel motors make it possible to regulate drive torque and braking force independently at each wheel without the need for any transmission, drive shaft, or other complex mechanical components [7]. Most conventional electrical machines (such as ac excited or brushed dc motors) are not suitable for application in – wheel motor drive because of their poor torque density and overload capability [8]. As such electric motors employed for this type of drive solution must have the following features: --High torque at low speed --Low weight especially where the motor has to be fitted in the rim in order to maintain road holding quality --High torque per kilogram and high torque per motor volume [9] -- Since the drive train in automotive applications operate under constantly varying torques and speed, the selection of electric motor for this application should be based on the overall cycle efficiency under varying drive conditions.

VI. ELECTRICAL MACHINES FOR HYBRID ELECTRIC VEHICLES

The motors and alternators used in hybrid electric vehicles are in principle not different from those used for other applications. However, in some instance like in parallel hybrid there are some modifications in their designs. In some applications, the electric motors are designed to be mounted directly in line with the engine crankcase. Such machines will in most cases be BLDC motor. They will be multiple – pole machines, since their location means their dimensions need to be short in length and wide in diameter. They are usually 'turned inside out' with the stationary coils being on the inside and the rotor being a band of magnets moving outside the coil. The larger diameter permits this construction, which has the advantage that the centrifugal force on the magnets tends to make them stay in place, rather than throw them out of their mounting. This type of inside out motor is used in motors that are integral with wheels (in – wheel motor). A major advantage of electric motor in hybrid electric drive is that torque generation is very quick and accurate [3]. Brief descriptions of some common types of electric motors used in hybrid vehicle drives are given below:

6.1 Brushed Direct Current Motor

Direct Current (DC) motors normally have windings in the rotor and permanent magnets in the stator. The permanent magnets are sometimes replaced by windings in the stator. Brushed DC Motors are very good electric motors in hybrid electric vehicle for motive propulsion. It has its maximum torque at low speed and the torque

steadily falls as the speed increases. This can be seen from the torque equation for a brushed DC Motor in equation . This gives it an edge over ICE that has its maximum torque at somewhat high speed.

6.2 Brushless Direct Current Motor (BLDC)

This is an AC motor. Other names given to it are permanent magnet synchronous motor, electronically commutated motor, self – synchronous motor etc. It is called brushless because the armature has no brushes connected to it. The rotor consists of a permanent magnet. The stator coil takes alternative supply from a dc source which generate magnetic field. The interaction of this magnetic field with that of the permanent magnet brings about the movement of the rotor (the permanent magnet).Due to back emf generated in the stator coil, the torque reduces as the speed increases (the back emf reduces the current in the coil). The advantage of this motor is that currents do not need to be induced in the rotor (like in induction motor), making them somewhat more efficient and giving slightly greater specific power. The disadvantage is that it is costlier due to the presence of permanent magnet.

6.3 Switched Reluctance Motor (SRM)

SRM is also called doubly salient machine. Here, both the stator and the rotor are made of irons which are magnetized by the current through the coil on the stator. Because the rotor is out of line with the magnet field, a torque will be produced to minimize the air gap and make the magnetic field symmetrical. Unlike the BLDC, , the current in the coil does not need to alternate. The main difficulty with SR motor is that the timing of the turning on and off of the stator currents must be much more carefully controlled. This motor has the reputation of being noisy due to the variable nature of the torque. This disadvantage is however reduced by adding more coils to the stator. The number of salient poles is always two less than the number of coils. Also, when using a core of high magnetic permeability, the torque that can be produced within a given volume exceeds that produced in induction motors and BLDC motors. Combining this with possibility of higher speed means that a higher power density is possible [10].

VII. POWER ELECTRONICS CONVERTERS (DRIVES)

7.1 Inverter

An inverter is a device that converts a direct current (DC) from battery or a similar source into an alternating current (AC) which can be used for driving AC electrical motors. It consists of a power module, DC link capacitors, sensors, a filter and a control system. The power module is made of high – power fast – acting semiconductor devices such as bipolar junction transistor (BJT), metal oxide semiconductor field effect transistor (MOSFET), insulated gate bipolar transistor (IGBT), silicon – controlled rectifier (SCR) etc. Electric machine is current intensive; therefore the switching devices must have the high current capabilities .

7.2 Rectifier

A rectifier does opposite of what an inverter does. It is a device that converts an alternating current (AC) from the utility grid to a direct current (DC) for direct current applications such as direct current (DC) motor drives. It also has all the components like the inverter. The switching devices are just like the ones used in inverter.

7.3 Two-Quadrant Converters

A two – quadrant converter is a converter that can act both as a rectifier and an inverter. It makes the flow of current and power in bidirectional form possible. This type of converter becomes necessary in hybrid electric vehicle drive because of the need to recover braking power through regeneration. Other types of converters that may find application in hybrid electric vehicle drive includes PWM DC/DC Buck, Boost, Buck-Boost and Cuk converter.

VIII. ELECTRIC VEHICLE TRACTION MODELING

Issues relating to performance and range in electric vehicle is very important. The first step in vehicle performance modeling is to produce an equation for the tractive effort. This is the force propelling the vehicle forward,

transmitted to the ground through drive wheels. For a vehicle of mass m, proceeding at a velocity v and moving up a slope (ϕ) .

The force propelling the vehicle forward, the tractive effort has to accomplish the following:

1. Overcome the rolling resistance
2. Overcome the aerodynamic drag
3. Provide the force needed to overcome the component of the vehicle's weight acting down the slope.
4. Accelerate the vehicle, if the velocity is not constant.

IX. CONCLUSTION

There are large and growing reasons why hybrid vehicles are the future of auto-industry worldwide. Among many advantages that have given hybrid vehicle edge over its internal combustion engine counterpart are as follows:

1. The internal combustion engine in a hybrid vehicle is much smaller, lighter and more efficient than the one in a conventional vehicle. This is because the engine can be sized for slightly above average power demand rather than peak power demand.
2. A standard combustion engine is required to operate over a range of speed and power, yet its highest efficiency is in a narrow range of operation where as in a hybrid vehicle, the engine operates within its range of highest efficiency.
3. The power curve of electric motors is better suited to variable speeds and can provide substantially greater torque at low speeds compared with internal combustion engines.
4. Braking in hybrid electric vehicle is controlled in part by the electric motor which can recapture part of the kinetic energy of the car to partially recharge the batteries. In a conventional vehicle, braking is done by mechanical brakes and the kinetic energy of the car is wasted as heat.
5. Hybrid vehicles are much more energy efficient than traditional internal combustion engine vehicles because they generally provide greater fuel economy. This statistic has a major implication for the reducing gasoline consumption and vehicle air pollution emissions worldwide.
6. There is reduced wear and tear on the gasoline engine.
7. There is reduced wear on brakes from the regenerative braking system use.
8. There is reduced noise emission resulting from substantial use of electric engine at low speeds leading to roadway noise reduction.
9. There is a reduced air pollution emission due to less fuel consumption per mile thereby leading to improved human health with regards to respiratory and other illnesses.

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