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HYBRID ELECTRIC VEHICLE (HEV)

Aditya y. Nannaware¹, Rakesh g. Dongare², Piyush v. Sorate³, Sarang N. Hiwarkar⁴

¹*Student (3rd year), Electrical Engineering Department, JDIET, Yavatmal, Maharashtra, INDIA*
adityananaware1998@@gmail.com

²*Student (3rd year), Electrical Engineering Department, JDIET, Yavatmal, Maharashtra, INDIA, rakeshgdongare@gmail.com*

³*Student (3rd year), Electrical Engineering Department JDIET, Yavatmal, Maharashtra, INDIA,*
piyushsorate1998@gmail.com

⁴*Student (3rd year), Electrical Engineering Department JDIET Yavatmal, Maharashtra, INDIA*
hiwarkars122@gmail.com

Abstract

With the advancement in 21st century, there has been increase in usage of oil and gas leading to problems like global warming, climate change, shortage of crude oil, etc. Due to these reasons automobiles companies have started doing research for making hybrid technology usable into daily life. In the present, more and more concern have been paid to the world energy conservation and environmental protection, therefore the development of electric vehicles are necessary. This topic was chosen because electric vehicles always been our interest because they represent future technology. In this research paper, actual effect of electric vehicle examined thoroughly. Electric vehicles have good environmental protection performance and can taking many kind of energy as power prominent characteristic, and electric vehicles are considered as green transportation. Nowadays, air pollution by vehicles and transporting system is major problem to the environment. so the automotive manufacturers, governments and environmental organizations are taking more care about electric vehicles. As it is zero emission pollution vehicles, electric vehicles can radically decrease exhausting pollution to improve air environment and adjust the energy structure. Electric Vehicle has attracted the great attention from researchers, leading to a series of intensive as well as extensive studies. With the development of high storage battery and EV, the number of EV will rise dramatically, so that the random charging and discharging behaviour will bring new challenges to safe and stable operation of power grids. The paper introduces briefly some aspect of EV, including studies on the government policies, impact of charging, and solutions to the related issues.

Index Terms: Working of HEV, Need of HEV, Basic of HEV, Future Scope.

1. INTRODUCTION

In today's fast developing world, air pollution is rapidly increasing and affecting most of the major cities of the world. This increase in air pollution is mainly due to the emission of carbon dioxide and other toxic gases from the vehicles which leads to increasing in global warming. Electrical vehicle is an automobile propelled by one or electric motors. This vehicle drawing power from onboard of electricity supply electric cars mechanically simpler and more durable than gasoline powered cars electric cars stores its energy in batteries, but alternatively with capacitors or flywheel storage device a more recent development is hybrid electric vehicle (HEV), which use both an electric motors and gasoline old diesel engine, which charges the batteries in order to extend the cars range can also to provide additional power. An electric car needs a controller,

which connected to the accelerator pedal, for directing the flow of electricity from the energy source to the motor. Most electric cars use lead acid battery but new types of batteries, including zinc chlorine sodium sulphur and nickel metal hydride are becoming more common. The motor of an electric car harnesses the battery's electrical energy by converting it into kinetic energy. The driver simply switches on the power. While the internal-combustion engine of a convectional car has many moving parts and must convert the linear motion of pistons and rods into rotary motions at wheels. An electric motor has only one rotating element. Like a gasoline powered car an electric car has a system (called power train) of gears, shafts and joints that transmit the motion from the motor to the cars wheels. Most of the electric cars do not have clutches or multispeed transmissions. In order to go backward side, the flow of electricity through the motor is reversed in direction,

changing the rotation of the motor and causing the power train to make the wheels rotate in the other direction.

Most electric cars have a regenerative braking system-the braking system act as a battery charger. When a driver ease up on the accelerator or step on brake pedal, the drive motor act as a generator and converts the vehicle's momentum back into electricity and stores it in the battery. Converting the kinetic energy into electric energy slows the car. Electric cars also have brake pedal and a traditional braking system, which uses friction to slow the vehicles for quick and emergency stopping. These friction brakes convert kinetic energy to heat. In gasoline powered cars this energy is wasted, the heat being dissipated into the surrounding air. Energy conservation in electric cars, however, is so important that engineers found a way to recover that heat and use it- for example, by heating the passengers compartment.

2. NEED OF ELECTRIC VEHICLES

Electric vehicle technology is gaining ground and popularity rapidly. With depletion of oil reserved smog, noise and all kind of pollutants. Government and communities are awaking to several benefit of EV technology. Zero emission vehicles are almost noiseless and can be charge at home or work, saving the time at endless queues at petrol pump. Charging at night when consumption is low, allow for efficient use of electricity. EVs are easier to service and maintain due to the absence of spark plug, clutch and gears. Ideal for "stop-start" city driving condition EVs are extremely reliable and easy to drive. With the number of advantages of EVs companies in developed countries have spent huge amount to develop electric cars that can travel longer distances, providing high level of comfort. In spite of this technology being available now the cost of electric vehicles to suit for driving requirements in these developed countries is high. On the surface of earth there are limited conventional energy sources. Their use to increase greenhouse gas emission and other environmental damages. In the future this conventional energy sources will be extinct. As per this condition conventional vehicles which run on the petrol and diesel are replacing by electric vehicles.

3. WORKING PRINCIPLE

A hybrid car has the internal combustion engine and fuel tank of traditional vehicles and the battery pack and electric motors of the electric automobiles. It usually work by collecting and reusing the energy of a gasoline burning engine that would otherwise go waste in standard vehicles. The working principle of E-vehicle is, an electric vehicle power source is the battery which act as a "gas tank" and supplies the electric motor with the energy necessary to move the vehicle. This gives the car acceleration. Controller acts as a regulator, and controls the amount of power received from the batteries so the motor does not burn out. An electric car stores its energy on board –typically in batteries. But alternatively with capacitors or flywheel storage devices.

3.1 MAIN SAFETY COMPONENTS IN AN HEV:

Circuit Breakers:

Circuit Breaker provides a fail safe manual interruption of the battery power in event of a drive system. It also provides convenient way to short of battery power during rutting servicing of the system. It must be installed in a location where it can be operated by the driver in addition; circuit breaker will trip automatically in case of malfunction creating a high current surge, and can be easily reset when the malfunction is corrected

Ignition key main contactor:

Contactor is used to switch high currents remotely by means of low level control voltage. In HEV high voltages, Inductive loads and extremely high current loads are encountered to switch a current under this condition requires specifically designed equipments.

Pot box:

Pot box is the interface between the throttle pedal and the speed controller. Its send a variable resistance to the controller to specify the amount of electricity to be release to the motor. It interface directly with any vehicles existing throttle control cable or linkage

Fusible Link:

Fusible link are should be inserted in the traction battery circuit in each pack in the vehicle. It will break the circuit in case of short circuit.

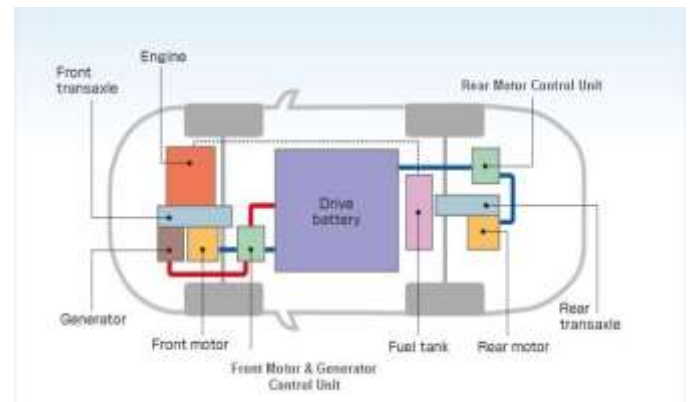


FIG.1. Working of HEV

3.2 BASICS OF HEV

I) Hybridization

A hybrid vehicle is a vehicle with multiple distinct energy sources which could be separately or simultaneously operated to propel the vehicle. Many hybridization configuration such as fuel cell, gas turbine, solar, hydraulic, pneumatic, ethanol electric and many more are proposed over the years. Among this the hybrid electric vehicles integrating two technically and commercially proven and well established technologies of electric motors and IC engine, allowing drawing upon their

individual benefits have been widely accepted by the technologies and users.

II) Hybrid Electric Vehicle (HEV)

This is the most commonly adapted hybrid vehicle which combines propulsion sources of an electric motors and IC engine. The power supply to the electric motors comes from the on board batteries. In a HEV, the IC engine co-operates with an electric motors which leads to a more optimal use of the engine. Driving in the city involves frequent starts and stops of the vehicle. During when the vehicle stop at signal, the engine consumes more fuel without producing useful work thus contributing to higher fuel consumption, less efficiency and unnecessary emission from exhaust. The HEV solves the problem by switching to power transmission through the motor and shutting of the engine. This way no fuel will be consumed during idling with no exhaust emission. Another advantage of HEV is that when the fuel tank get empty while driving the engine the vehicle can be driven on electric power within its maximum range.

III. TYPES OF HYBRID POWER TRAIN

Power train in any vehicle refers to the group of components that generates power and deliver it to the road surface. Hybrid vehicle can be classified into three basics categories of power train system which are briefly discussed below.

A. Series Hybrid

This an electric power train for which an IC act as a generator to charge batteries and provide power to the electric drive motor which can be seen in the fig.1. This vehicle usually has larger batter pack and larger motors with smaller IC engines.

Series hybrid can improve the efficiency by minimizing the losses in battery. They deliver peak energy during acceleration and taking regenerative energy during breaking.

A complex transmission between the motor and wheel is not needed, as electric motors are efficient over a wide speed range. If the motors are attached to the vehicle body, flexible coupling are required.

Some vehicles designed have separate electric motors for each wheel. Motor integration into the wheels has the disadvantage that unstrung mass increase, by decreasing ride performance. Advantages of individual wheel motors include simplified traction control (no conventional mechanical transmission elements such as gear box, transmission shaft, and differential), all wheel drive, and allowing lower floor.

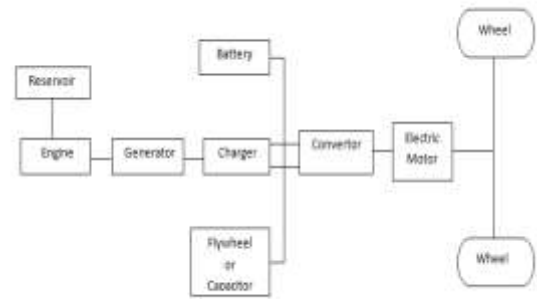


FIG. 2. Structure of Series Hybrid Vehicle

B. Parallel Hybrid

Parallel system has both an internal combustion engine (ICE) and an electric motor in parallel connected to a mechanical transmission. Most design combine a large electrical generator and a motor into a one unit, often located between the combustion engine and the transmission. The battery can be recharged during regenerative breaking and during cruising (when the ICE power is higher than the required power for propulsion).

Usually the combustion engine operates as the primary means of propulsion and the electric motor acting as a backup.

The advantages of this are smaller batteries and generally more efficient regenerative breaking to both slow the car and capture energy while doing so. Another advantage is that it can be easily incorporated into existing vehicle models rid.

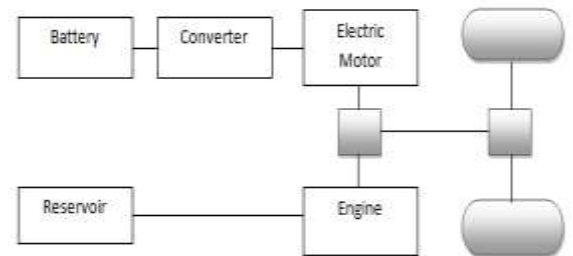


FIG. 3. Structure of Parallel Hybrid Vehicle

C. Series Parallel Hybrid

This drive train is combination of the two drive train types, allowing for vehicles to operate as all – electric, as all combustion vehicles, or as a combination of the two (as a parallel hybrid). This is the most complex and least efficient power train for most application. Combine hybrid systems have features of both series and parallel hybrid. There is a double connection between the engine and the drive axel: Mechanical and electrical. This split power path allows interconnecting mechanical and electrical power, at some cost in complexity. Power split devices are incorporated in the power train. The power to the wheel can be either mechanical or electrical or both. This also the case in parallel hybrid. but main principle behind the combine system is the decoupling of the power supplied by the engine from the power demanded

by the driver. In conventional vehicles, a larger engine is used to provide acceleration from standstill than one needed for steady state cruising. This is because of combustion of engine torque is minimum at lower RPMs, as the engine is its own air pump. In combined hybrid at lower speed, this system operates as a series HEV, while at has speed, where the series power train is less efficient, the engine takes over. This system is more expensive than a pure parallel system as it needs an extra generator, a mechanical split power system and more computing power to control the dual system.

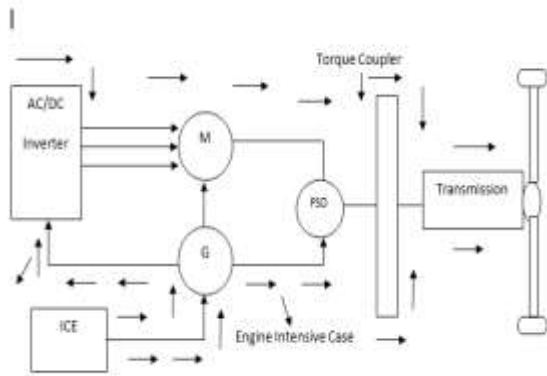


FIG. 4 Structure of Series Parallel Hybrid Vehicle

Energy Saving Potential of Hybrid Drive train

In terms of overall energy efficiency, the advantages of hybrid over conventional vehicles are:

I. Regenerative Braking: A hybrid can capture some of the energy normally lost as heat to the mechanical brakes by using electric drive motors in generator mode to break the vehicle

II. More Efficient operation of the ICE including reduction of idle: A hybrid can avoid some of the energy losses associated with the engine at speed and load combination where the engine is inefficient by using the energy storage device to either absorb part of the ICE output or augment it or even substitute for it. This allows the ICE to operate only at speed and load where it is most efficient when HEV stopped, rather than running engine at idle, where it is extremely inefficient, the control system may either shut of the engine, with the storage device providing auxiliary power, or run on the engine at a higher and than idle power setting use the excess power to recharge the storage device.

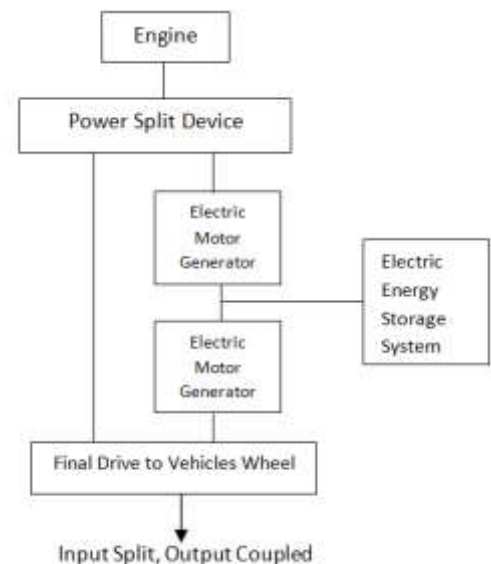
III. Smaller ICE: Since the storage device can take up a part of load, the HEV ICE can be down sized The ICE may be sized for the continues load and not for the very high shot term acceleration load. This enables the ICE to operate at higher fraction of its rated power, generally at higher fuel efficiency during most of the driving.

IV. Potential for higher weight : Although the fuel driven energy source on a hybrid generally will be of lower power and weight than the engine in a conventional vehicle of similar performance, total hybrid weight is likely to be higher than the conventional vehicle it replaces because of the added weight of storage device, electric device, other component. This depends, of course, on the storage mechanism, chosen vehicle performance requirement and so forth.

V. Electrical Losses : Although individual electric drive train components tends to be quite efficient for one way energy flows back and forth through component in a way that Leads to cascading losses further, sum of the component may be force to operate under condition where they have efficiency. For Example, like ICE most electric vehicle have lower efficiency at low speed low load conditions often encountered in City driving without careful component selection and control strategy that minimizes electric losses, much of the theoretical efficiency advantage often associated with an electric drive train can be lost.

C. Complex Hybrid:

This System has one major difference with the series parallel System that is it allowed by directional flow of power where as the series parallel can provide only unidirectional power flow however, using current market terminologies, the configuration is denoted as series parallel system too. High complexity and cost are drawback of this system, but it is adopted by some vehicles to use dual axle propulsion. Constantly variable transmission (CVT) can be used for power splitting in a complex hybrid system or choosing between the power sources to drive the wheels. Electric arrangement can be used for such processes and this is dubbed as e-CVT, which has been developed and introduced by Toyota motors. CVT can implement hydraulically, mechanically, hydro-mechanically or electro-mechanically. Two methods of power splitting-input splitting and complex splitting are shown in given figure. Most of input splitting got the name as it has power split device placed at transmission input. This System is used by certain Toyota and Ford



4. Basic Component of Hybrid Vehicle

Regardless of the type of the hybrid vehicle system, the propulsion system is mainly comprised of the following components:

Electric motors, regenerative braking,

4.1 Electric motor

Electric motors is also called as drive assist, motor generator or electric drive in hybrid electric vehicle, the electric motor provide additional power to assist the engine in accelerating , passing , or hill climbing. In some vehicles, the electric motor by- itself can provide enough power for low-speed driving ,where internal combustion engine are list efficient. While they mostly only provide supplemental acceleration, the maximum speed and distance over which electric-only operation can be sustained varies from essentially zero to a handful of miles, and is dependant on weight, aerodynamics and battery capacity, among the other things.

4.2 Regenerative Braking

Normal cars wheel will waist al of their excess momentum in the from of heat in the brakes. In hybrid vehicles, regenerative brakes absorbs a portion of the vehicles momentum when slowing or costing down hill and converts it into electricity. How does this work ? the electric motor applies resistance to the drive train causing the wheel to slow down. In return, the energy from the wheel turn the motor, which function as a generator, converting energy normally wasted during costing and braking into electricity, which is stored in a battery until needed by the electric motor. Regenerative braking is insufficient to stop car quickly, so conventional hydraulic brakes are still necessary.

Advantages:

An electric car is really great way for us as a consumer we can save a lot of money on gas. However, there re so any reasons why we should invest in electric car in modern day of technology.

1. Cost effective:

Earlier owing electric car would cost a bomb. But with more technological advancement, both cost and maintenance have gone down. The mass production of batteries and available tax incentives have further brought down the cost, thus making it much more cost effective.

2. No emission:

Electric car are 100 percent eco friendly as they run on electrically powered engines. It does not emit toxic gases for smoke in the environment as it run on clean energy source. They are even better than conventional car as they are running on gas produced emission. Hybrid vehicle contributing to healthy and green climate.

3. Reduced noise pollution:

Conventional car produced noise pollution but electrical hybrid car produced less noise as compared to hybrid electrical vehicles. Electric motors are cable of providing smooth drive with higher acceleration over longer distances. Many owners of electric cars have reported positive savings of up to 100 of thousands of rupees a year. Considering the demand for oil will only be going up as the supply run out and electric car will most likely be the normal mode of transportation in coming the coming future.

4. Safe to drive:

Electric hybrid cars undergo same tasting procedures and fitness test as other fuel powered cars. In case accidents occur, one can expect air bags to open up and electricity supply to cut from battery. This can prevent driver and other passenger in the car from the serious injuries.

5. Future of HEV in India:

Hybrid car are future of car industry before going total electric as due to emission problem as well as increase in pollution there is need to go for higher emission standard. So there is a wide scope for hybrid car.

When entire world is facing the scarcity of petrol and the gasoline prices are touching the sky. Hybrid car have come up as a promising and a feasible option to cope with situation. The use of hybrid electric vehicle is being encouraged by many government in the world.

Electric Vehicles are growing in popularity and certainly in mind space they cleaner and more efficient. Their growth, however, is still considered just a market problem: the end user should choose on the basis of what its cost to buy and run or how it performs, etc. Market, matter, but there is also a need for government and policy input.

In April 2014, Indian government announced a new plan to provide subsidies up to rupees 150,000/- for cars and rupees 30,000/- on two wheelers. India aims to have 7 million electric vehicles on road buy 2020. Government also giving benefits on tax for HEV buyers which is 12% from normal cars buyers which is 28% .

Conclusion:

HEVs have great potential of becoming the future of transport while saving this planet from imminent calamities cause by global warming. They are a viable alternative to conventional vehicles that depend directly on the diminishing fossil fuel reserves. The HEV types, configuration, energy sources, motors, power conversion and charging technologies for HEVs have been

discussed in detail in this paper. The key technologies of each section have been reviewed and their characteristics have been presented. The impacts HEVs cause in different sectors have been discussed as well, along with the huge possibilities they hold to promote a better and greener energy system by collaborating with smart grid and facilitating the integration of renewable sources.

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