Hybrid Electric Vehicles

Vinay k m[#1], Isaac Raju[#2]
[#1]Student, Department of Mechanical Engineering, CBIT kolar, India.
[#2]Student , Department of Mechanical Engineering, CBIT kolar, India.

Abstract: *The presented paper discuss the diffusion of Hybrid electric technology in vehicles. The hybrid engine in vehicles has the potential to reduce fossil fuel use, decrease pollution, and allow renewable energy sources for transportation. Conventional vehicles use gasoline or diesel to power an internal combustion engine. Hybrids also use an internal combustion engine and can be fueled like normal cars but have an electric motor and battery, and can be partially or wholly powered by electricity. Hybrid cars can be configured to obtain different objectives, such as improved fuel economy, increased power, or additional auxiliary power for electronic devices and power tools. Many technologies like regenerative braking, electric motor drive, automatic start or shutoff are being used in hybrid cars to make them as good as conventional vehicles.*

Keywords: *Electric motors, Battery, Regenerative braking, Hybrid engine.*

1. INTRODUCTION

In today's fast developing world, air pollution is rapidly increasing and affecting most of the major cities of the world. These increased is mainly due to the emission of carbon dioxide and other toxic gases from the vehicles which leads to gradual increasing in global warming. And also demand for utilization of fossil fuels is increasing at a greater rate as the use of vehicles is fast growing.

In order to overcome and minimize these criteria hybrid engines were introduced.
A hybrid vehicle is a vehicle that uses two or more distinct power sources to move the vehicle. The term most commonly refers to hybrid electric vehicles (HEVs), which combine an internal combustion engine and one or more electric motors.

A hybrid vehicle uses multiple propulsion systems to provide motive power. The most common type of hybrid vehicle is the gasoline-electric hybrid vehicles, which use gasoline (petrol) and electric batteries for the energy used to power internal-combustion engines (ICEs) and electric motors. These motors are usually relatively small and would be considered "underpowered" by themselves, but they can provide a normal driving experience when used in combination during acceleration and other maneuvers that require greater power.

The presence of the electric power train is intended to achieve either better fuel economy than a conventional vehicle or better performance.

II. BASICS OF HEV

A. 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 configurations such as fuel cell, gas turbine, solar, hydraulic, pneumatic, ethanol, electric and many more are proposed over the years. Among these, the hybrid electric vehicles, integrating two technically and commercially proven and well established technologies of electric motors and I.C. engine, allowing drawing upon their individual benefits have been widely accepted by the technologies and users.

B. Hybrid Electric Vehicle (HEV)

This is the most commonly adapted hybrid vehicle which combines propulsion sources of an electric motor and an I.C. engine. The power supply to the electric motor comes from onboard batteries. In a HEV, the I.C. engine cooperates with an electric motor which leads to a more optimal use of the engine. Driving in city traffic involves frequent starts and stops of the vehicle. During idling, 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 off the engine. This way no fuel will be consumed during idling with no exhaust emission. Another advantage of HEV is that when fuel tank gets 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 generate power and deliver it to the road surface. Hybrid vehicles can be classified into three basic categories of power train systems which are briefly discussed below.

A. Series Hybrid

This is an electric power train for which an I.C. engine acts as a generator to charge batteries and provide power to the electric drive motor which can be seen in Fig.1. These vehicles usually have a larger battery pack and larger motors with smaller I.C. engines.

Series hybrids can be assisted by ultracaps, which can improve the efficiency by minimizing the losses in the battery. They deliver peak energy during acceleration and take regenerative energy during braking.

A complex transmission between 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 couplings are required.

Some vehicle designs have separate electric motors for each wheel. Motor integration into the wheels has the disadvantage that the unsprung mass increases decreasing the ride performance. Advantages of individual wheel motors include simplified traction control (no conventional mechanical transmission elements such as gearbox, transmission shafts, and differential), all wheel drive, and allowing lower floors.

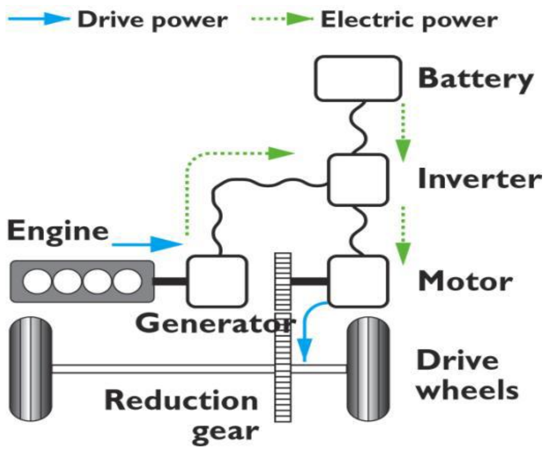
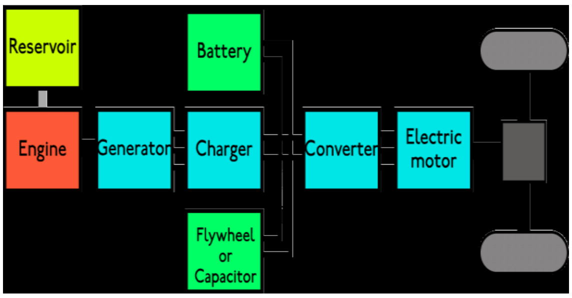


Fig1: **Structure of series hybrid vehicle.**



B. Parallel hybrid

Parallel hybrid systems have both an internal combustion engine (ICE) and an electric motor in parallel connected to a mechanical transmission.

Most designs combine a large electrical generator and a motor into one unit, often located between the combustion engine and the transmission, replacing both the conventional starter motor and the alternator. The battery can be recharged during regenerative breaking, and during cruising (when the ICE power is higher than the required power for propulsion).

More mechanically complex than a series hybrid, the parallel power train is dual-driven, allowing both the combustion engine and the electric motor to propel the car. Fig.2 shows that the I.C. engine and motor operate in tandem. Usually the combustion engine operates as the primary means of propulsion and the electric motor acting as a backup or torque/power booster. The advantages of this are smaller batteries (less weight) and generally more efficient regenerative braking to both slow the car and capture energy while doing so. Another advantage is that it can easily be incorporated into existing vehicle models.

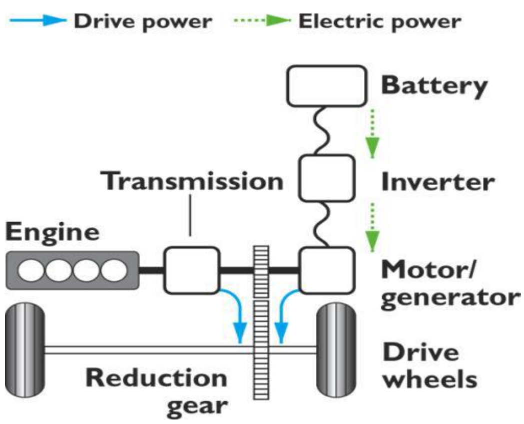
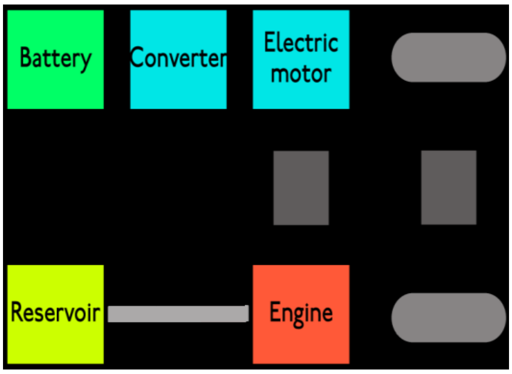


Fig2: Structure of parallel hybrid vehicles



C. Series-Parallel Hybrid

This drive train is a combination of the two drive train types, allowing for the vehicle to operate as all-electric (as a series hybrid), as an all combustion vehicle, or as a combination of the two (as a parallel hybrid). This is the most complex and least efficient power train for most applications.

Combined hybrid systems have features of both series and parallel hybrids. There is a double connection between the engine and the drive axle: 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 wheels can be either mechanical or electrical or both. This is also the case in parallel hybrids. But the main principle behind the combined system is the decoupling of the power supplied by the engine from the power demanded by the driver.

In a conventional vehicle, a larger engine is used to provide acceleration from standstill than one needed for steady speed cruising. This is because a combustion engine's torque is minimal at lower RPMs, as the engine is its own air pump. On the other hand, an electric motor exhibits maximum torque at stall and is well suited to complement the engine's torque deficiency at low RPMs.

In a combined hybrid at lower speeds, this system operates as a series HEV, while at high speeds, where the series powertrain 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
.

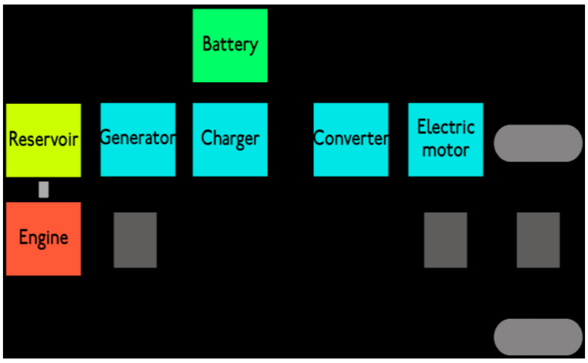


Fig3: Simplified structure of a combined hybrid electric vehicle.

IV. WORKING PRINCIPLE

In a traditional hybrid vehicle, we have a complete electric car. It includes an electric motor to provide all of the power to the wheels, as well as batteries to supply the motor with electricity and a completely separate gasoline engine powering a generator. The engine is very small (10 to 20 horsepower) and it are designed to run at just one speed for maximum efficiency. The purpose of this small, efficient engine is to provide enough power for the car at its cruising speed.

During times of acceleration, the batteries provide the extra power necessary. When the car is decelerating or standing still, the batteries recharge. This sort of hybrid car is essentially an electric car with a built-in recharger for longer range. A regenerative braking system used in automobiles converts the kinetic energy produced while stopping the vehicle into a storable energy form, rather than allowing it to dissipate as heat, which is the case in conventional braking systems. The energy that is recouped during braking is saved and re-routed into the battery packs, which in turn provides power to the electric motor that then supplements the main drive engine. The advantage is that the small, efficient gasoline engine gets great mileage.

CONCLUSION

Hybrid-electric vehicles (HEVs) combine the benefits of gasoline engines and electric motors and can be configured to obtain different objectives, such as improved fuel economy, increased power, or additional auxiliary power for electronic devices and power tools

The transmission of power using freewheels and chain wheels are very cheap and reliable. One disadvantage is that driving on electric power is not a good option for a long distance travel. Though this combined power train system can become much useful in more stop and go traffic situations. With the use of this powertrain system, the overall fuel consumption and fuel economy is improved. Such vehicle would run on fuel but would use its electric motor to boost the power when needed. The costs of HEVs are a little more than the conventional cars but they more efficient and the exhaust emissions are less.

REFERENCES

[1] Satti Swami Reddy, Kola Siva Tharun, Eco Friendly Vehicle, International Journal of Engineering Trends and Technology (IJETT), 4(4), April 2013, 957-960.
[2] Trajkovic, S., Tunestal, P., and Johansson, B., "Vehicle Driving Cycle Simulation of a Pneumatic Hybrid Bus Based on Experimental Engine Measurements," SAE Technical Paper 2010-01-0825, 2010, doi:10.4271/2010-01-0825.
[3] Husain, Electric and Hybrid Vehicles-Design Fundamentals, Boca Raton, CRC Press, 2003.
[4] Charters, D., 2008. MIRA Case Study: Hybrid 4WD vehicle (H4V).