IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 12, Issue 2 Ver. VI (Mar - Apr. 2015), PP 11-14
www.iosrjournals.org

Hybrid Electric Vehicle

Rushikesh Trushar Soni
Mechanical Engineering Department
Sardar Vallabhbhai National Institute of Technology, Surat, India

Abstract: *Today we face the problem of dwindling fuel resources for vehicles. There is no doubt that the emission of carbon-dioxide from an automobile exhaust is also a pressing concern for the increasing rate of global warming. One of the optimistic solutions for such problems is the hybridization of the vehicle. HYBRID ELECTRIC VEHICLE is a combination of a conventional internal combustion engine and an electric propulsion system. It implies that HEV can be driven on I.C. engine as well as on electric power. HEV produces less emissions compared to a similar-sized gasoline car as the gasoline engine of the HEV can be geared to run at maximum efficiency. The significance of electric power train is that it runs with lesser power loss, hence improving the overall fuel economy. Encouraging hybridization of vehicles can reduce of CO2 emission and thus the fuel costs. At present, hybrid electric vehicles are widely available in commercial vehicles, military vehicles and passenger cars.*
Keywords: *Chain wheel, Freewheel, Reverse one-way clutch, Sprocket*

I. Introduction

Recently renewed interest in reducing dependence on fossil fuels, coupled with increasing pressures to create more environmentally begin modes of transportation, have compelled the automotive and fuel production industries to investigate alternative fuels. Consumer demand for high maximum power leads to the increased engine displacement. Since I.C. engine exhibits low efficiency at part load, the mean efficiency of the propulsion system is decreased. Many researchers have contributed in exploring and evaluating these alternatives from various perspectives. Daniel and Rosen have discussed the availability, cost, performance and emission related several issues. Introduction of hybridization in vehicles will solve most of the problems that a conventional vehicle is facing. The hybrid vehicles, with inherent abilities to significantly reduce fuel consumption and emissions without compromising with performance and safety are by far emerging as the most viable and promising alternative option worth considering. This paper mainly explains a type of powertrain system of HEV.

II. Basics of HEV

2.1 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.

2.2 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 Powertrain

Powertrain 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 powertrain systems which are briefly discussed below.

3.1 Series Hybrid

This is an electric power train for which an I.C. engine acts as a generator to charge batteries and/or 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.

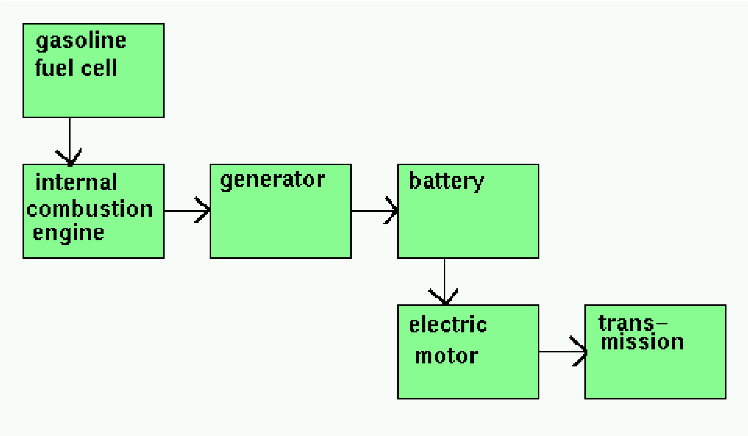

Figure 1: series hybrid powertrain

They are referred to as "Plug-In Hybrids" (or a Plug-In Electric Vehicle, PHEV) and "Range-Extended Electrics." The drive train for a series hybrid is mechanically simple, compared to other hybrids. Disadvantages to this drive train are lower efficiencies at greater trip distances and the higher cost of batteries and components, since the vehicle is all-electric. Regardless, of the three hybrid options, it is the most efficient in fuel use [1].

3.2 Parallel Hybrid

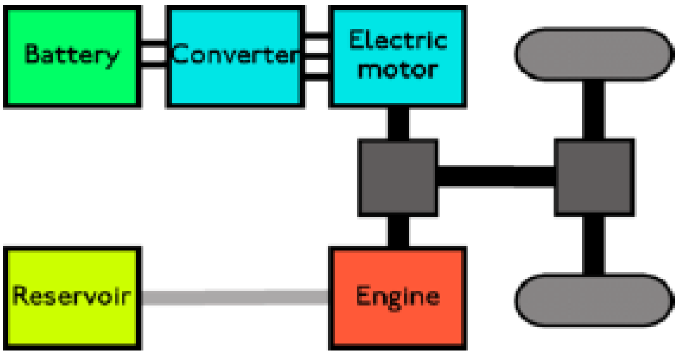

Figure 2: parallel hybrid powertrain

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. Most hybrids on the road are of the parallel type. The major disadvantage of this power train is that it adds more weight to the vehicle without necessarily shrinking the engine and other components. While the addition of the motor does increase fuel mileage by allowing the engine to operate at lower rotations per minute (thus using less fuel). These vehicles are poor highway performers, gaining most of their efficiency in city driving at lower speeds.

3.3 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 powertrain for most applications.

IV. Powertrain using Chain-Sprocket Mechanism

A new type of powertrain is introduced here using freewheels and chain wheels. In parallel hybrid powertrain system two power sources are mechanically coupled. If they are joined at some axis truly in parallel, the speeds at this axis must be identical and the supplied torques add together. With cars it is more usual to join the two sources through a differential gear. Thus the torques supplied must be the same and the speeds add up, the exact ratio depending on the differential characteristics. When only one of the two sources is being used, the other must also rotate in an idling manner. In this case, the idle source can be connected to the output shaft using freewheel or a one-way clutch. When only one of the two sources is being used, the other must still supply a large part of the torque or be fitted with a reverse one-way clutch or automatic clamp.

The gearbox assembly gets its power from the power-transmitting shaft, which is the most important component of any vehicle. The power-transmitting shaft is mounted on the chassis at an optimal position and it is supported by bearings mounted on the chassis. The shaft is connected by a chain-sprocket mechanism.

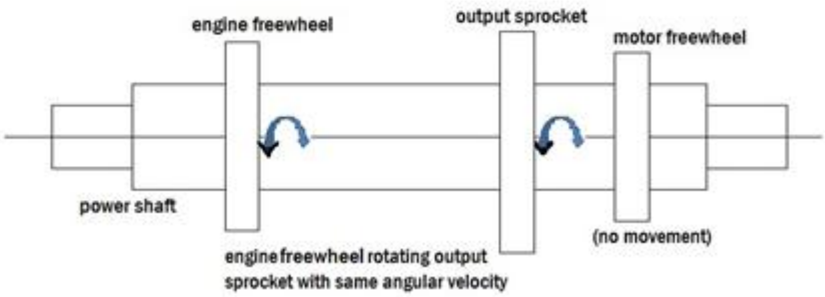

Figure 3: transmission from engine

The power shaft is welded with total three sprockets. Two of the sprockets are freewheels, the ones that are connected on the rear wheel of a bicycle. Each of the two freewheels on the shaft are coupled with the engine input and electric motor input using a chain drive power transmitting assembly and are welded onto the shaft on its either ends. The uniqueness of freewheel is that it disengages the driveshaft from the driven shaft when the driven shaft rotates faster than the driveshaft. That means, this sprocket transmits power only in one direction and rotates freely if rotated in the opposite direction. The third sprocket on the shaft is a conventional chain wheel coupled with the gearbox assembly input using chain drive power transmitting mechanism. This chain wheel is welded onto the power-transmitting shaft at the center portion. This will make sure that it will rotate all the time irrespective of whether the power-transmitting shaft is driven by the electric motor or the engine. The motor output shaft is mounted with the same freewheel as used on the power shaft with same module and number of teeth since no amplification or reduction of RPM is required.

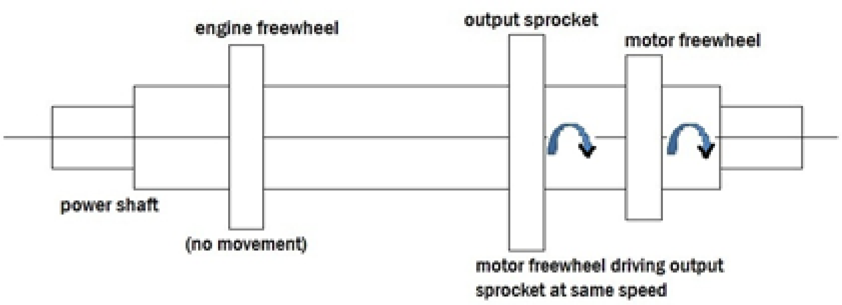

Figure 4: transmission from motor

The direction of rotation of electric motor is kept opposite to that of the engine crankshaft. So if the crankshaft is rotated in one direction, power will be transmitted from engine only and electric motor will not contribute as freewheel mounted on the motor output shaft rotates freely (Fig. 3). Further, if the motor is rotated in the opposite direction, power will be transmitted through the motor only and not through the crankshaft as freewheel on the crankshaft will rotate freely (Fig. 4). As a result, it will always drive the gearbox assembly, and further transmit power to the wheels. The clutch is included in the gearbox assembly. The above-explained system makes power shaft run by both engine and motor individually.

V. Charging of Batteries

When driving a vehicle on electric motor, the stored energy in the batteries gets used up quickly. Batteries of a HEV can be charged either by solar charging or through regenerative braking.

5.1 Regenerative braking

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 [2].

5.2 Solar battery charging

The solar energy transformation is an efficient way to save even more energy. It increases over all efficiency as the cost per unit of the electricity can be saved. Charging the battery using solar power will be a challenge but can turn out to be a good scope for further development as solar power is freely available.

VI. Conclusion

The transmission of power using freewheels and chain wheels is 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 cost of HEVs are a little more than the conventional cars but they more efficient and the exhaust emissions are less.

Acknowledgements

I sincerely thank Dr. S. A. Channiwala (Professor, Mechanical Engineering Department, SVNIT, Surat) for providing his valuable suggestions and indispensable help throughout the project.

References

Journal Papers:

[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.