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HYBRID VEHICLE : THE BOON OF REVERSE ENGINEERING.

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Abstract –

Looking with the advancements in the present century, electric vehicles seem to be the only future of the automobile industry! But what about the currently running gasoline vehicles, hybrid vehicles are a broad concept about the same. The Paper starts from brief history about Hybrid Technology and also some introduction on it. Paper will also discuss the technologies used in the making of Hybrid Cars such as "Hybrid Solar powered Vehicle", "Hybrid Electric powered Vehicle" and "Plug In hybrid electric vehicles. The concept of hybrid vehicles, increases the efficiency of the current only ic engine vehicles. The paper consists of the various types of hybrid vehicles including the concept of regenerative braking.it consists of explanation of the related topics, efficiency of this concept, examples with studies on present hybrid vehicles such as Volvo xc90, Toyota Innova Hy cross, BMW xm. Paper concludes the advantages & disadvantages of the hybrid cars, and how it can be an alternative to petrol and diesel cars rather than directly shifting to electric cars.

Key Words: Hybrid Electric Vehicle, Hybrid Solar Vehicle, Plug In Hybrid Electric Vehicle, Volvo XC90, Regenerative Braking.

1.INTRODUCTION

The commercial production of automobiles started back in the year 1896 in the United States; over the decades, many evolutions took place in the internal combustion engine. The effiency of the engines went on increasing, also the rate of gasoline went up. But it never affected the production of new vehicles round the corner. The production of electric vehicles (EVs) began several years ago, with the first commercially available electric cars hitting the market in the early 2010s. The modern era of EV production gained significant traction with the introduction of the Tesla Roadster in 2008 electric vehicles were introduced in the market & it got a huge response by the people. But people never thought on the topic of "what to do about the existing fuel vehicles running on diesel and petrol?", Hybrid vehicles is the answer to this. With proper research & implementation of design, hybrid vehicles can be a major relief to the gasoline powered vehicle's owners, as their cars will not be remained as scrap after the emergence of electric vehicles. Various companies to work on the same factor but they emerge with the electric technology on compound basis. Here we stand out the point that the existing vehicles can be re-designed and fitted with batteries.

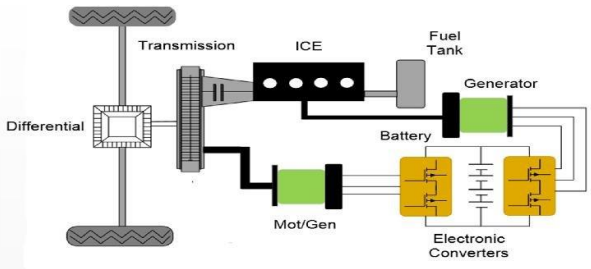

Fig 1: Working principle of Hybrid Vehicle.

The concept of retrofitting petrol vehicles with batteries to convert them into hybrid vehicles is called “hybridization or retrofitting”. The basic principle of a hybrid vehicle is to combine the use of an internal combustion engine (petrol or diesel) with an electric motor and battery system. The electric motor provides additional power and assists the internal combustion engine, resulting in improved fuel efficiency and reduced emissions. Retrofitting a conventional petrol vehicle into a hybrid involves installing the electric motor, battery pack, power control unit, and other necessary components. This process can be complex and may require modifications to the vehicle's drivetrain, electrical system, and chassis. It is typically performed by specialized conversion companies or automotive workshops with expertise in hybridization.

1.1 Regenerative braking.

The concept of regenerative braking converts the heat loss due to the conventional braking method into electrical energy. When the vehicle applies brakes, the electric motors situated in the wheels, act as generators re-generating the kinetic energy into the electric energy & storing them back into the battery system.it increases the overall efficiency of the vehicle, also the energy recovery helps to reduce the fuel consumption and thus increasing the vehicle’s range. Along with regenerative braking some vehicles use co-operative braking system which consists of both the conventional and the regenerative method too. The concept of this type of braking overall enhances the driving experience along with saving the wastage of kinetic energy & also the heat loss.

2. Types of hybrid vehicle:

A. Mild Hybrids

One of the newest innovations in hybrid technology is that of a “mild” hybrid system. Like the name implies, a mild hybrid system typically isn’t going to propel the vehicle on electric power alone. Instead, the system is used to give a small boost to the vehicle’s gasoline engine, typically upon acceleration from a dead stop, and to assist in removing the burden of power-hungry systems, such as air conditioning, on the gasoline engine. Normally found in the form of 48-volt electric systems, mild hybrids do not need to be plugged in. Instead, the batteries are recharged through a combination of power from the gasoline engine, and energy recovered when the vehicle brakes also known as regenerative braking as mentioned above.

B. Full Hybrids

Like mild hybrids, full hybrid vehicles also come equipped with both a gasoline engine and an electrical component. However, the electrical component in a full hybrid vehicle is capable of handling far more of the workload than that of a mild hybrid. Most full hybrids can actually operate for some distance solely on electric power. This typically happens at lower city speeds, but is one reason why you may see a full hybrid’s City MPG rating higher than its Highway MPG rating (where in standard gasoline-powered vehicles, the opposite is true).

C. Plug-In Hybrids

All of the hybrid vehicles that we have discussed thus far charge their batteries solely through internal means. The main difference with plug-in hybrids is that these vehicles can charge their batteries via external chargers as well as internal. As a result, plug-in hybrids usually have greater electric-only ranges than full hybrids. Plug-In hybrids essentially serve as a half-way point between full hybrid vehicles and fully electric vehicles.

D. Electric Vehicles with Range Extender Hybrids

While all-electric vehicles technically don’t qualify as hybrids, there are some that come equipped with a small gasoline engine to provide a cushion when needed. When an electric vehicle runs out of power, the vehicle will need to be charged before it becomes operational again. These range extender hybrids utilize their gasoline engine to charge the battery or power the electric motor so that you’re not left stranded. Depending on the size of the gasoline engine, this can mean anywhere from a few dozen miles to hundreds

Table -1:

	MICRO	MILD	FULL
Power(kw)	2.5	10-25	30-50
Voltage (v)	12	100-200	200-300
Energy saving (%)	5-10	20-30	30-50
Price inflammation	3	20-30	30-40

When it comes to full hybrid vehicles, there are two main types of powertrains; Parallel hybrids and Series hybrids.

With Parallel hybrids, the engine can be powered in one of 3 ways: directly by the engine, directly by the electrical motor, or by both systems working together.

In a Series hybrid, the wheels are powered solely via the electric motor, with the gasoline-engine providing power for the electric motor, sort of like a generator. The gasoline-engine never actually powers the wheels.

With advances in hybrid technology, some vehicles operate as a combination of the two (aptly named "series-parallel" hybrids), with the on-board computer system choosing the most efficient way to operate at any given time.

Full hybrids charge their battery system in essentially the same way as mild hybrid systems, through energy from the gasoline engine as well as regenerative braking.

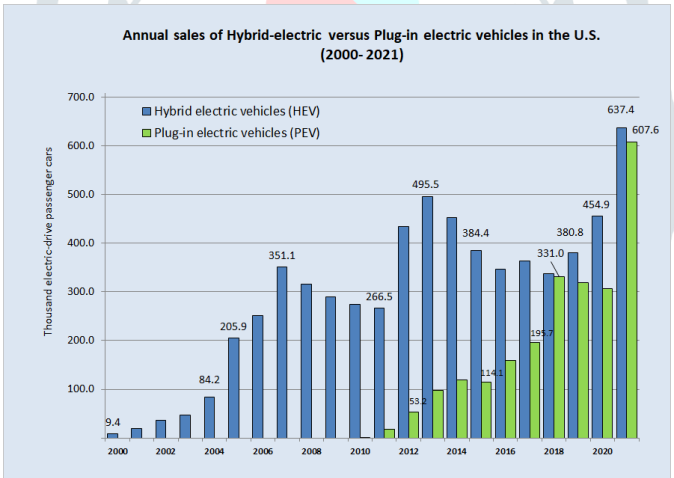

Chart -1: Annual sales of hybrid-electric versus plug-in electric vehicles in the U.S

The above chart indicates the sales of one decade starting from 2000-2021.

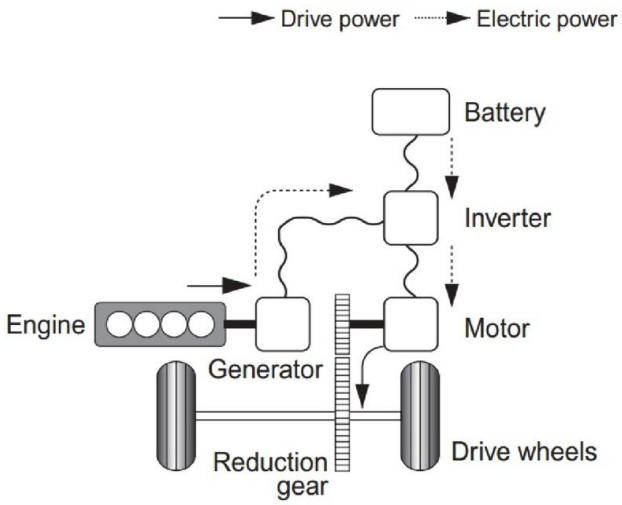

Fig -2: Series hybrid vehicle

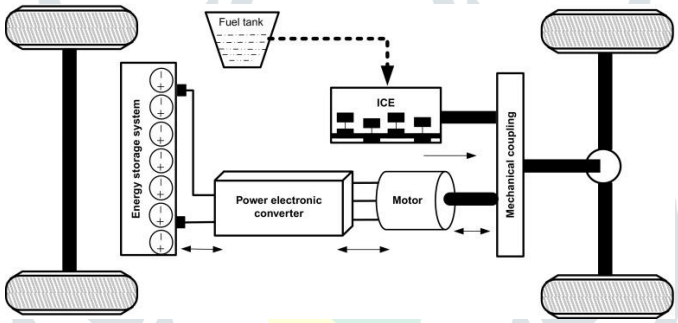

Fig-3: Parallel hybrid vehicle

3.Advantages And Disadvantages Of Hybrid Vehicle:

Advantages:

I. Fuel efficiency-One of the primary advantages of hybrid vehicles is their improved fuel efficiency. Hybrids combine an internal combustion engine with an electric motor, allowing them to achieve better fuel economy compared to conventional vehicles.

II. Regenerative braking-Hybrid vehicles use regenerative braking, which converts the kinetic energy generated during braking into electrical energy. This energy is then stored in the battery and used to power the electric motor, reducing the reliance on the combustion engine and further improving fuel efficiency.

III. Potential cost savings-Although hybrid vehicles may have a higher upfront cost compared to conventional vehicles; they can potentially save money in the long run. With better fuel efficiency, owners can spend less on fuel, and some governments offer tax incentives or rebates for purchasing hybrid vehicles, making them more financially attractive.

Disadvantages:

I. Higher Initial Cost: Hybrid vehicles tend to have a higher upfront cost compared to conventional vehicles. The technology involved in hybrid systems, including the battery pack and electric motor, contributes to the increased cost. However, as technology advances and economies of scale improve, the price of hybrid vehicles is gradually becoming more competitive.

II. Limited Electric Range: Most hybrid vehicles are not designed to operate solely on electric power for long distances. They rely on the combustion engine for extended driving, and the electric motor provides supplementary power. As a result, the electric range of hybrids is typically limited compared to fully electric vehicles.

III. Battery Degradation and Replacement: The batteries in hybrid vehicles can degrade over time, resulting in reduced performance and efficiency. While manufacturers often provide warranties for the battery pack, eventual replacement may be necessary, which can be expensive. However, advancements in battery technology are improving longevity and reducing costs.

4. CONCLUSIONS

The above paper concludes that the existing gasoline (petrol and diesel) vehicles can be converted into hybrid vehicles by retro-fitting or the process called as hybridization. Hybridization increases the overall efficiency of the vehicle, also increasing the range & affordability in general. The cost of retro-fitting a vehicle is higher but the minimal cost is better than directly shifting to an electric vehicle.

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