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HYBRID MOTOR VEHICLE

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ABSTRACT

Hybrid vehiclesare vehicles with two or more power sources in the drivetrain. There are many different types of hybrid vehicles, although only the gasoline-electric hybrid is currently commercially available. Hybrids are classified by the division of power between sources; both sources may operate in parallel to simultaneously provide acceleration, or they may operate in series with one source exclusively providing the acceleration and the second being used to augment the first's power reserve. The sources can also be used in both series and parallel as needed, the vehicle being primarily driven by one source but the second capable of providing direct additional acceleration if required. Current hybrids use both an internal combustion (IC) engine and a battery/electric drive system to improve fuel consumption, emission, and performance. Electrically-assisted pedal bicycles are a form of hybrid drive. Other combinations of energy storage and conversion are possible, although not yet in commercial production. Combustion-electric hybrids have larger battery sets than what a normal combustion engine only vehicle would have. Battery and supercapacitor technology is advancing. A potential advantage is that when these battery sets require renewing in the future, the newer battery sets will be potentially superior having higher energy storage giving greater range enhancing a vehicle.

Keywords: - IC Engine, Hybrid Drive, Hybrid Vehicle, Acceleration

I. INTRODUCTION

A hybrid electric vehicle (HEV) has two types of energy storage units, electricity and fuel.

Electricity means that a battery (sometimes assisted by ultra-caps) is used to store the energy, and that an electromotor (from now on called *motor*) will be used as traction motor. Fuel means that a tank is required, and that an Internal Combustion Engine (ICE, from now on called *engine*) is used to generate mechanical power, *or* that a fuel cell will be used to convert fuel to electrical energy. HEVs are powered by an internal combustion engine or other propulsion source that runs on conventional or alternative fuel and an electric motor that uses energy stored in a battery. The extra power provided by the electric motor allows for a smaller engine, resulting in better fuel economy without sacrificing performance. HEVs combine the benefits of high fuel economy and low emissions with the power and range of conventional vehicles. HEVs do not require a plug to charge the battery; instead, they charge using regenerative braking and the internal combustion engine. They capture energy normally lost during braking by using the electric motor as a generator, storing the captured energy in the battery. The energy from the battery provides extra power during acceleration and auxiliary power when idling.[2]

II. PLUG-IN HYBRID ELECTRIC VEHICLES

PHEVs are powered by conventional fuels and by electrical energy stored in a battery. Using electricity from the grid to charge the battery some of the time costs less and reduces petroleum consumption compared with conventional vehicles. PHEVs can also reduce emissions, depending on the electricity source. PHEVs have an internal combustion engine or other propulsion source and an electric motor, which uses energy stored in a battery. PHEVs have larger battery packs than HEVs, making it possible to drive using only electric power (about 10 to 40 miles in current models). This is commonly referred to as the all-electric range of the vehicle. PHEV batteries can be charged several ways: by an outside electric power source, by the internal combustion engine, or through regenerative braking. If a PHEV is never plugged in to charge, its fuel economy will be about the same as that of a similarly sized HEV. If the vehicle is fully charged and then driven a shorter distance than its all-electric range, it is possible to use electric power only.

III. TYPES BY DRIVETRAIN STRUCTURE

3.1 Series Hybrid

In a series hybrid system, the combustion engine drives an electric generator (usually a three-phase alternator plus rectifier) instead of directly driving the wheels. The electric motor is the only means of providing power to the wheels. The generator both charges a battery and powers an electric motor that moves the vehicle. When large amounts of power are required, the motor draws electricity from both the batteries and the generator. Series hybrid configurations already exist a long time: diesel-electric locomotives, hydraulic earth moving machines, diesel-electric power groups, loaders.Series hybrids can be assisted by ultra-caps (or a flywheel: KERS=Kinetic Energy Recuperation System), which can improve the efficiency by minimizing the losses in the battery. They deliver peak energy during acceleration and take regenerative energy during braking. Therefore, the ulracaps are kept charged at low speed and almost empty at top speed. Deep cycling of the battery is reduced, the stress factor of the battery is lowered. 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 unsprang mass increases, decreasing 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, which is useful for buses. Some 8x8 all-wheel drive military vehicles use individual wheel motors. [1]

IV. WEAKNESSES OF SERIES HYBRID VEHICLES

The ICE, the generator and the electric motor are dimensioned to handle the full power of the vehicle. Therefore, the total weight, cost and size of the powertrain can be excessive. The power from the combustion engine has to run through both the generator and electric motor. During long-distance highway driving, the total efficiency is inferior to a conventional transmission, due to the several energy conversions.

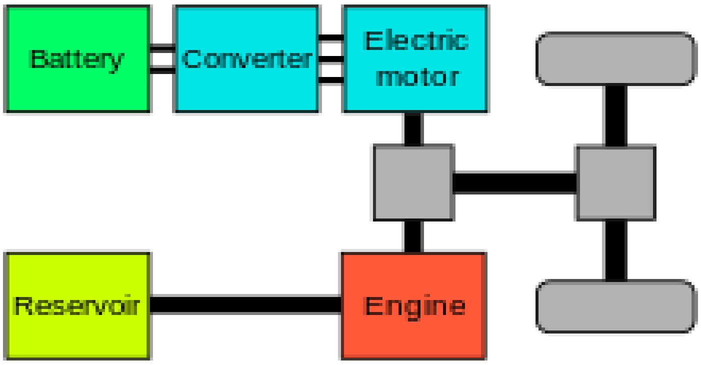
V. ADVANTAGES OF SERIES HYBRID VEHICLES

There is no mechanical link between the combustion engine and the wheels. The engine-generator group can be located everywhere. There are no conventional mechanical transmission elements (gearbox, transmission shafts). Separate electric wheel motors can be implemented easily. The combustion engine can operate in a narrow rpm range (its most efficient range), even as the car changes speed. Series hybrids are relatively the most efficient during stop-and-go city driving.

VI. 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 (see figures above). The battery can be recharged during regenerative breaking, and during cruising (when the ICE power is higher than the required power for propulsion). As there is a fixed mechanical link between the wheels and the motor (no clutch), the battery cannot be charged when the car isn't moving.

When the vehicle is using electrical traction power only, or during brake while regenerating energy.



Structure of a Parallel Hybrid Electric Vehicle

VII. WEAKNESSES OF PARALLEL HYBRID VEHICLES

Rather complicated system. The ICE doesn't operate in a narrow or constant RPM range, thus efficiency drops at low rotation speed. As the ICE is not decoupled from the wheels, the battery cannot be charged at standstill.

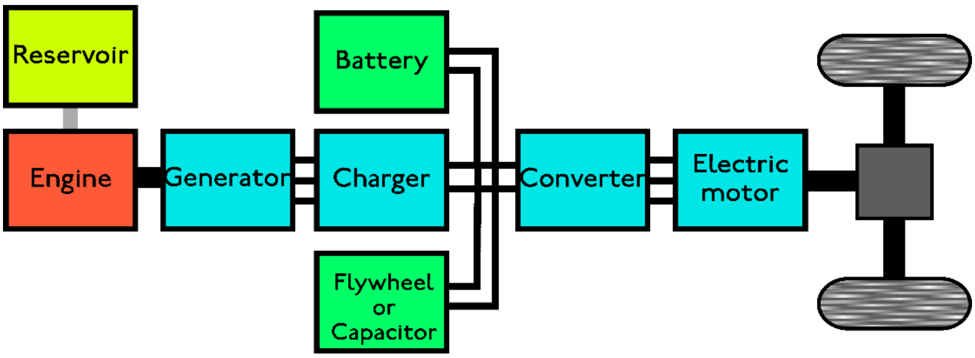
VIII. ADVANTAGES OF PARALLEL HYBRID VEHICLES

Total efficiency is higher during cruising and long-distance highway driving. Large flexibility to switch between electric and ICE power Compared to series hybrids, the electromotor can be designed less powerful than the ICE, as it is assisting traction. Only one electrical motor/generator is required.

IX. COMBINED HYBRID

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 powertrain. 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 drive .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, a smaller, less flexible, and highly efficient engine can be used. It is often a variation of the conventional Otto cycle, such as the Miller or Atkinson cycle. This contributes significantly to the higher overall efficiency of the vehicle, with regenerative braking playing a much smaller role. 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.[3]



Simplified Structure of a Combined Hybrid Electric Vehicle

X. WEAKNESSES OF COMBINED HYBRID VEHICLES

Very complicated system, more expensive than parallel hybrid. The efficiency of the power train transmission is dependent on the amount of power being transmitted over the electrical path, as multiple conversions, each with their own efficiency, lead to a lower efficiency of that path (~70%) compared with the purely mechanical path (98%).

XI. ADVANTAGES OF COMBINED HYBRID VEHICLES

Maximum flexibility to switch between electric and ICE power .Decoupling of the power supplied by the engine from the power demanded by the driver allows for a smaller, lighter, and more efficient ICE design

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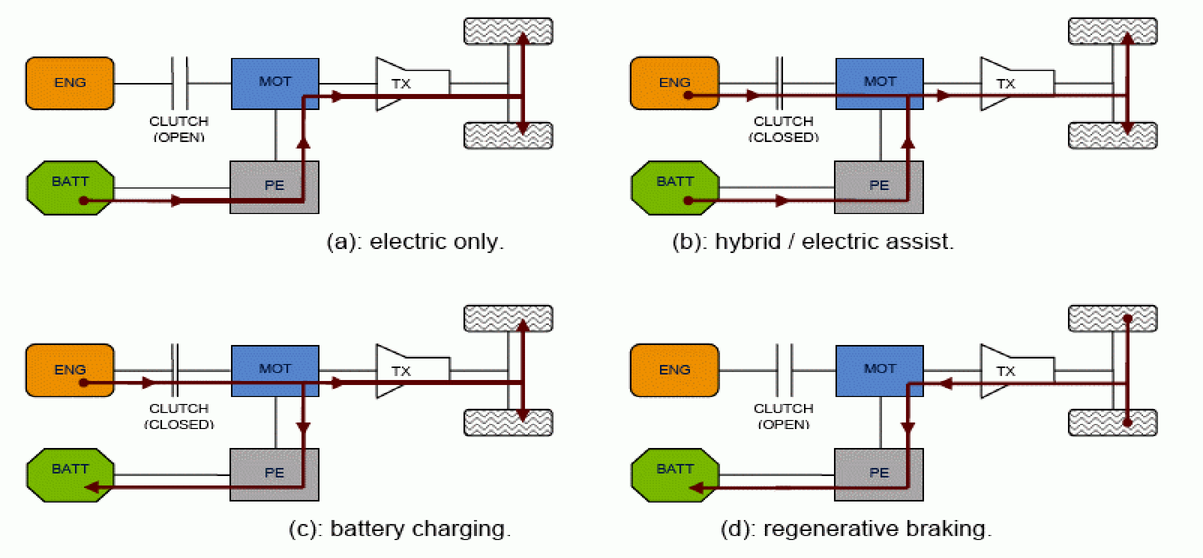
XII. OPERATION MODES

The parallel configuration supports diverse operating modes



Some typical modes for a parallel hybrid configuration

PE = Power electronics TX = Transmission

XIII. TYPES BY DEGREE OF HYBRIDIZATION

Parallel and combined hybrids can be categorized depending upon how balanced the different portions are at providing motive power. In some cases, the combustion engine is the dominant portion; the electric motor turns on only when a boost is needed. Others can run with just the electric system operating.

XIV. STRONG HYBRID (= FULL HYBRID)

A full hybrid EV can run on just the engine, just the batteries, or a combination of both. A large, high-capacity battery pack is needed for battery-only operation.

XV. MEDIUM HYBRID (= MOTOR ASSIST HYBRID)

Motor assist hybrids use the engine for primary power, with a torque-boosting electric motor connected in parallel to a largely conventional powertrain. EV mode is only possible for a very limited period of time, and this is not a standard mode. Compared to full hybrids, the amount of electrical power needed is smaller, thus the size of the battery system can be reduced. The electricmotor, mounted between the engine and transmission, is essentially a very large starter motor, which operates not only when the engine needs to be turned over, but also when the driver "steps on the gas" and requires extra power. The electric motor may also be used to re-start the combustion engine, deriving the same benefits from shutting down the main engine at idle, while the enhanced battery system is used to power accessories. The electric motor is a generator during regenerative breaking.

XVI. MILD HYBRID / MICRO HYBRID (= START/STOP SYSTEMS WITH ENERGY RECUPERATION)

Mild hybrids are essentially 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. During restart, the larger motor is used to spin up the engine to operating rpm speeds before injecting any fuel. That concept is not unique to hybrids; Subaru pioneered this feature in the early 1980s, and the Volkswagen Lupo 3L is one example of a conventional vehicle that shuts off its engine when at a stop. As in other hybrid designs, the motor is used for regenerative braking to recapture energy. But there is no motor-assist, and no EV mode at all. Therefore, many people do not consider these to be hybrids, since there is no electric motor to drive the vehicle, and these vehicles do not achieve the fuel economy of real hybrid models. Some provision must be made for accessories such as air conditioning which are normally driven by the engine. Those accessories can continue to run on electrical power while the engine is off. Furthermore, the lubrication systems of internal combustion engines are inherently least effective immediately after the engine starts; since it is upon start-up that the majority of engine wear occurs, the frequent starting and stopping of such systems reduce the lifespan of the engine considerably. Also, start and stop cycles may reduce the engine's ability to operate at its optimum temperature, thus reducing the engine's efficiency. [4]

XVII. PLUG-IN HYBRID (= GRID CONNECTED HYBRID = VEHICLE TO GRID V2G)

All the previous hybrid architectures could be grouped within a classification of charge sustaining: the energy storage system in these vehicles is designed to remain within a fairly confined region of state of charge (SOC). The hybrid propulsion algorithm is designed so that on average, the SOC of energy storage system will more or less return to its initial condition after a drive cycle. A plug-in hybrid electric vehicle (PHEV) is a full hybrid, able to run in electric-only mode, with larger batteries and the ability to recharge from the electric power grid. Their main benefit is that they can be gasoline-independent for daily commuting, but also have the extended range of a hybrid for long trips. Grid connected hybrids can be designed as charge depleting: part of the “fuel” consumed during a drive is delivered by the utility, by preference at night. Fuel efficiency is then calculated based on actual fuel consumed by the ICE and its gasoline equivalent of the kWh of energy delivered by the utility during recharge. The "well-to-wheel" efficiency and emissions of PHEVs compared to gasoline hybrids depends on the energy sources used for the grid utility (coal, oil, natural gas, hydroelectric power, solar power, wind power, nuclear power). In a serial Plug-In hybrid, the ICE only serves for supplying the electrical power via a coupled generator in case of longer driving distances. Plug in hybrids can be made multi-fuel, with the electric power supplemented by diesel, biodiesel, or hydrogen.[5]

XVIII. CONCLUSION

Hybrid cars are definitely more environmentally friendly than internal combustionvehicle. Batteries are being engineered to have a long life. When Hybrid cars become more widespread, battery recycling will become economically possible. Research into other sources such as fuel cells and renewable fuel make the future look brighter for hybrid cars. Thus there will be little reduction in the

Consumption of Fossil Fuel foe Combustion Process. Hybrid car will therefore give better efficiency and performance in less input of fuel. Thus will make a Great change In Future.

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