

Comparative study on performance of traditional engine and hybrid and electric engine

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Abstract. In the past, the car brands led by Mercedes Benz are extremely popular world-widely and those cars are mainly designed using internal combustion engines. Engine technology is also innovating in real time. Today's new energy technology is representing the development of low pollution and high efficiency in our country. In China, the growth of new energy vehicles, however, is especially rapid and, as a whole, China is the largest automobile market in the world, ranking first in production and sales scale. Despite fluctuations in recent years, China has maintained a steady but increasing development trend. Since China's accession to the WTO, new energy vehicles are blooming in the world, the shares of sustainable energy bought by everyone is constantly climbing and the scale of production and sales has grown rapidly. In 2009, China surpassed the United States to become the world's largest new car consumption market, and has always maintained a high growth rate. However, traditional cars and internal combustion engine vehicles gained some denial.

Keywords: world-widely, Engine technology, new energy vehicles

1. Introduction

In terms of the energy consumption structure of automobiles, there is a significant gap between old and new energy sources. In absolute terms, fuel cars are still the main consumption force, but the increase trend is weak. The rapid development of new energy vehicles, "oil for electricity" speed up. According to the China Automobile Association, the sales volume of conventional fuel vehicles in 2021 was 22.754 million, down 5% year on year. The total sales volume of new energy vehicles reached 3.521 million units, up 157.5% year on year. The annual penetration rate of new energy vehicles was 13.4%, up 8 percentage points [1].

To begin with, this paper selected Electric Vehicles, Hybrid Vehicles and Internal Combustion Engine Vehicle and aim to give specific comparison between those popular kinds of vehicles.

2. Heat engine

2.1 History of engine

With theout competition between companies, there will be no development of the industrial chain. Looking back at the global automobile industry for nearly 100 years, it is not only a history of industry competition, but also a history of technological innovation. As we all know, automobile energy includes gasoline, diesel engine, natural gas, hybrid power, pure electric vehicle, plug-in hybrid power, mileage and so on [2]. However, these energy changes have been developed for more than 130 years. Many people think that the rapid development of cars originated from the first gasoline car invented by Karl Benz in 1885, but this is not the case. The ancestor of the automobile is the steam train invented in 1870, which should be derived from the word "steam" of the automobile [3].

In 1881, with the use of lead-acid batteries, electric cars charged by lead-acid batteries were born, with a maximum range of 40 kilometers, and were applied in urban commuting, short distance transportation and other practical markets. Four years later, since Benz invented the first fuel

automobile, Because of the development of internal combustion engine technology and the continuous market competition, the automobile has entered the era of three pillars of steam locomotive, electric vehicle and gasoline diesel vehicle [4]. With the passage of time, after 1925, due to the low technical efficiency of the steam turbine, the relatively high cost of the electric vehicle, and the backward technical development trend, the market capacity of the two became smaller and gradually withdrew from the platform, and the automobile electric energy began to monopolize the crude oil vehicle.

Since the 1960s and energy into the electrification, new energy and even the development of the intelligent stage, as part of the industrial cities, such as California, the haze of the British London suffered from automobile exhaust, and the first oil crisis of 1973, to lower emissions, lightweight, electrification trend began to affect the automobile industry [5]. The development of related materials, power electronics, secondary batteries and fuel cells has also brought new attention to electric vehicles, gradually affecting the development pattern of the automotive energy field.

2.2 Internal combustion engine

However, the internal combustion engine is still a highly recommended type nowadays. Comprising a heat engine in which ignition takes place in a closed space called a combustion chamber. Ignition of natural gas will cause ultra-high pressure and high temperature gas, which can surge. The expanded gas is used to immediately promote the learning of piston rod, turbine blade, motor rotor or automobile engine itself [6]. The whole process could be divided into 4 different stages shown below. First of all, the engines suck air from the environment into compression cylinder and, then, the reciprocating piston inside the compression cylinder compresses the air pressure and temperature. The piston compresses the air up to such high temperature that when the fuel pump injects fuel and mixes fuel with the compressed air, which are used to generate power. After the compression stroke, the expansion would be started while combusting. This process is known as expansion process as the air-fuel mixture passes through valve, which will force the piston to move up and down continuously. Finally, the exhaust stroke is taking as those useless gases expelled from cylinders and new air was compressed in [1]. Figure 1 is a schematic diagram of four working processes of an injection combustion (IC) engine.

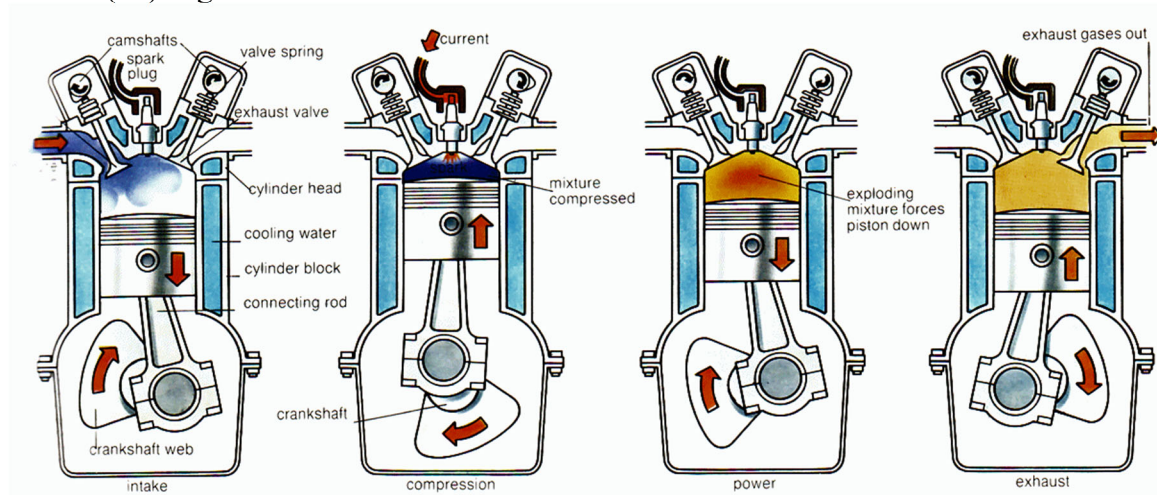


Figure 1. The four working process of the IC engine.

2.3 The benefits of CI engine

In far more deep understanding, the IC or IS engine would be more ideal sometimes. One of the reasons is that the range of the driving displacements can be ensured and are more likely to move longer distance [7]. Nowadays, there are huge amount of power stations provided gasoline and diesel built every where along the roads and high-speed ways, which significantly reduces the times that cars stopped at the roads due to the lack of energy sources. Moreover, the energy tank in a car would be 4% for whole car so people do not need to worry whether the gasoline would be quickly used up

if the tank is full of it. Furthermore, what is considered as the benefit of the IC engine is that all components of the internal combustion engine are operating at an average temperature lower than the temperature of the operating fluid in the operating cycle. Mainly because the high temperature of the working fluid in the circulation is only a small part of the continuous circulation time. Therefore, the fluid with strong operating temperature can also be used thermally under medium and high pressure [8].

3. Electric engine

3.1 The pure electric motor

The battery electric cars are preferred by a lot of people who want to purchase a electric cars because they think those cars are uncommonly eco-friendly. It is definitely correct but I want to illustrate more deeply about it. PMSM is the most common motor offered in Battery Electric Vehicles (BEVs) and This is also a new energy electric vehicle, which uses the energy stored in the rechargeable battery pack professionally, and does not help to promote the source. Because permanent magnets generate the magnetic field of permanent magnet synchronous motor, the influence of excitation current can be effectively avoided and thus reducing excitation loss, commonly known as copper loss. However, the disadvantage of permanent magnet synchronous motor is that it needs more unit torque current, resulting in larger energy consumption [9].

In addition, the characteristic curve of permanent magnet synchronous motor [2] under light load is much higher than that of asynchronous motor [3]. Therefore, permanent magnet synchronous motor is designed as the top level in energy saving efficiency. When the motor-driving energy is insufficient for proper working, its power operation will not reach the suitable level and the motors will not work as well. At the same time, the power margin of the motor may be further retained by the operators in case the motor works under abnormal conditions. On the other hand, the designer reserved a certain power margin for the motor according to the needs of different users so as to ensure the reliability of the motor. Therefore, in the actual operation of the motor, its rated power is below 70%, which means the motors usually work in light load circumstances.

3.2 The comparison between CI and Hybrid

Generally speaking, in internal combustion engines, especially reciprocating internal combustion engines, ethanol combustion of carbon containing fuel will also produce carbon monoxide, some soot, metal oxides of nitrogen and sulfur, and some unburned nitrogen oxides [10]. Depending on the operating standard. In comparison, hybrid electric motor and pure electric motor would be more likely to have lower negative effects on the environment. In the figure shown below, we can see that the engines using petrol and diesel as fuel always have huge carbon dioxide emissions at the Tank-to-Wheel (TTW) stage between 100 and 120 grams per kilometer and the Wall-to-Wheel (WTW) stage between 115 to 145 grams per kilometer, which are much greater than the statistical value of that emissions for PHEV and BEV [4-5]. As for those electric cars, the Tank-to-Wheel efficiency is extremely high because there would be negligible loss of electricity from the cables connected to the coal-burning power station, particularly for BEV, which have almost zero CO₂ emissions in the process. Figure 2 is a comparison of WTW, TTW and WTT emissions for different vehicles.

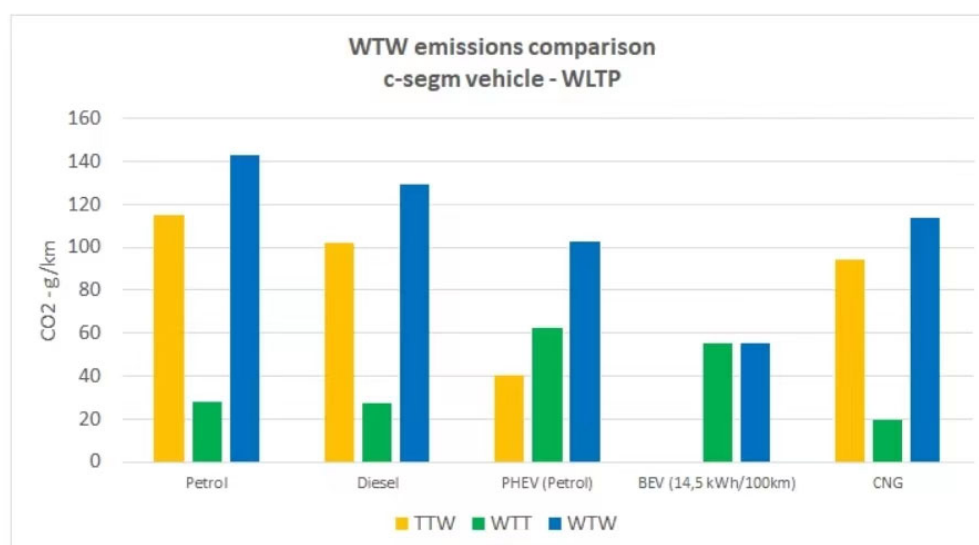


Figure 2. The WTW, TTW and WTT emissions comparison for different vehicles.

Like the hybrid vehicle, it can use the braking technology to park at the green light, and can not use the gasoline engine when the traffic is serious. When the gasoline engine is stopped, the pollutant particles are not discharged into the air. Carbon monoxide and carbon dioxide are common harmful pollutants discharged into the air when gasoline engines are started. Turquoise car club shows that hybrid vehicles can reduce 90% of exhaust emissions [6] methyl tert butyl ether pollutants released from vehicle gasoline into the air, causing cancer. Therefore, hybrid electric vehicles are not only beneficial to health, but also beneficial to the natural environment [7].

4. Results and discussion

All categories of cars have their both individual benefits and drawbacks. IC engines are the most acceptable cars today not only because it is onerous to change the traditional habit on driving but also because they have more different brand to choose what cars people prefer more. In the conditions, it is important to consider the harmful damage that the gaseous pollution caused by the burning of the gasoline and people should be aware of protective methods which could largely recover or prevent the hurts.

In addition, the hybrid electric cars are partly niche because the majority of the publics have not directly acquired multiple knowledge related and it is obvious that, with the aspects from public, the pure electric cars are the more popular without a doubt. However, in my opinion, Hybrid and pure are both good choices. Although they have quite limited range of driving and the charging time period would be a lot longer at present, the they provide high starting torque that can reduce the time used to accelerate till the speed is acceptable for different people and makes less greenhouse gases or harmful gases that might led to destruction of natural environment. There are also some drawbacks for them but what people concerned more about are whether the price is affordable. To explain clear, many articles and news have shown that battery electric cars industry are improving frequently and the technologies utilized in it will upgrade faster that we thought. The problems are more likely to be solved and the prices for the common BEVs would be as low as possible in the future.

5. Conclusion

Based on the positive history of the development of the cars, I believe that no matter the veteran or the new force, only by taking the new advanced concept as the lead, taking the new energy renewal as the main line, and mastering the core key technology can they be more competitive in present market and win new competitive advantages.

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