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DWUPALIWOWY SYSTEM WYSOKOPRĘŻNEGO SAMOCZYNNEGO ZAPŁONU

Streszczenie: Technologia, oznaczana angielskim skrótem RCCI, odnosi się do silników wysokoprężnych, pozwala ona na użycie w tym samym czasie dwóch paliw tj. oleju napędowego oraz benzyny w komorze spalania. Takie rozwiązanie umożliwia znaczącą redukcję zużycia paliwa, ale wywołuje emisję niepożądanych substancji. W dalszej części pracy stwierdza się jednak, że zastosowanie metody spalania RCCI umożliwia uzyskanie wielkich oszczędności. Można także znacząco zredukować emisję, przy czym można usunąć katalizatory z procesu spalania.

Słowa kluczowe: emisja, silnik z samoczynnym zapłonem, system dwupaliwowy

REACTIVITY CONTROLLED COMBUSTION IGNITION SYSTEM

Summary: RCCI technology is a combustion engine that allows the use of diesel and gasoline in combustion at the same time, which can achieve a significant reduction in fuel consumption and thus the production of unwanted emissions. It follows that by using the RCCI combustion method, huge savings could be achieved, and by rapidly reducing emissions, the catalyst could also be omitted from the combustion process.

Keywords: Emisions, internal combustion engine, RCCI

1. Introduction

RCCI technology is a reactive controlled compression combustion method. RCCI is a method of double combustion of fuel, which is based on the fact that two currently used fuels have a significant difference in reactivity, which allows the use of two different fuels at the same time, which can achieve a significant reduction in fuel consumption and thus produce undesirable emissions. It follows that by using the

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RCCI combustion method, huge savings could be made, and by rapidly reducing emissions, less greenhouse CO2 and less nitrogen oxides, the catalyst could also be omitted from the combustion process, thus achieving partial reduction of the weight of the power unit and thus also the total weight of the vehicle. [1,2,4,5]

2. RCCI technology

RCCI technology is a combustion method that allows the use of diesel and gasoline in the combustion at the same time, which can achieve a significant reduction in fuel consumption and thus the production of unwanted emissions. It follows that by using the RCCI combustion method, huge savings could be made, and by rapidly reducing emissions, less greenhouse CO2 and less nitrogen oxides, the catalyst could also be omitted from the combustion process, thus achieving partial reduction of the weight of the power unit and thus also the total weight of the vehicle. Lower vehicle weight is just one of the few benefits of the RCCI engine. Because this engine works more efficiently, it has a higher efficiency, up to 60%, which is more than 20% for petrol engines and 10% more for diesel engines. The engine therefore also provides higher power, as it operates at a higher efficiency and thus more potential energy of the fuel is converted into working power and less converted into waste energy. [2,3,5]

2.1. Principle of operation of the RCCI engine

As mentioned in the introduction, the RCCI engine (Reactivity Controlled Combustion Ignition) engine combines the use of two fuels. One highly reactive and the other fuel with significantly lower reactivity. The two fuels enter the combustion chamber via two injectors (Fig. 1). [5,6]

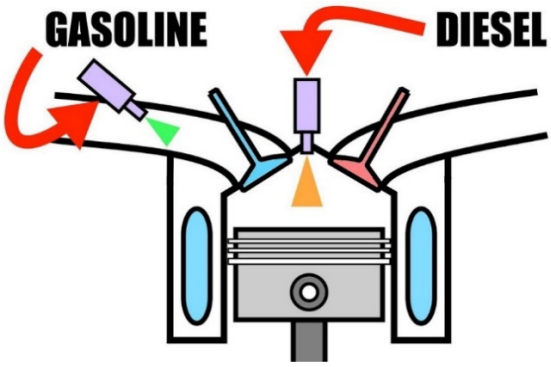

Figure 1. Principle of operation of the RCCI engine

In the combustion chamber, the combustion of mixed fuels takes place, which is very interesting, because the RCCI engine is equipped with two types of injection, direct and indirect. The injection and mixing of these two fuels into a homogeneous fuel mixture itself takes place in three stages. In the first phase, the first batch of low reactivity fuel indirectly enters the cylinder and is injected in front of the intake valve. During the intake cycle, this dose of low reactive fuel forms a first layer in the area of the inner surfaces of the cylinder. In the next phase, the first batch of diesel, as a highly reactive fuel, enters the cylinder directly through the injector. This dose of fuel forms a mixture of both fuels during the compression movement upwards towards the top of

the cylinder together with the fuel deposited on the walls of the cylinder. As the piston gradually moves upwards, this mixture mixes and becomes homogeneous. The third phase begins when the piston reaches the upper position of the cylinder. Then another, slightly smaller, dose of highly reactive diesel fuel is injected into the homogeneous mixture in the cylinder.[1,6,7]

During the actual upward movement of the piston, not only a homogeneous mixture of the two fuels was formed, but also compression took place, by means of which an increased temperature was created in the cylinder. However, this is not enough to ignite the entire volume of the mixture. However, the temperature is high enough to ignite the last batch of diesel. In this phase, the so-called cold flame combustion takes place. However, this combustion cannot in itself create sufficient pressure on the piston itself. In this process, the temperature in the cylinder rises even more and thus the second part of the mixture of low-reactive fuel and diesel is ignited. Several points of combustion of the mixture in the cylinder are created (Fig. 2). This mixture eventually ignites a mixture of low reactive fuel and air in the cylinder. [2,3,4]

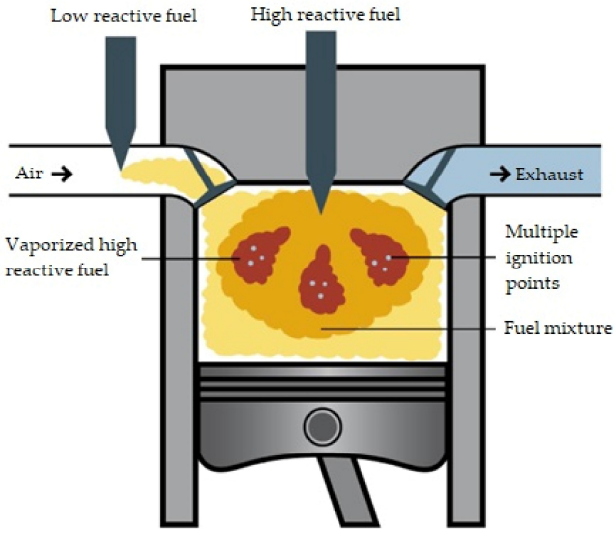

Figure 2. Formation of multiple ignition points

2.2. Tested fuel combinations

So far, the RCCI engine is only in experimental form. However, if it can be reworked into a form suitable for longer-term operation of the vehicle under normal traffic conditions, this will be a significant milestone in the development of internal combustion engines as we know them, as the RCCI engine combines the use of two different fuels with different combustion cycles. The use of two fuel combination options is currently being tested. The first option is to use a diesel-gas combination. Specifically, it is the use of compressed natural gas (CNG). An alternative to this combination is to use a petrol - diesel combination. Research and experimentation have shown that it is more appropriate to use a combination of diesel - and compressed natural gas (CNG), as this has a significantly lower reactivity than petrol and is therefore more suitable for use in this type of engine. [1,5]

3. Conclusion

Despite its many advantages such as low emissions, high efficiency, and lower fuel consumption, the RCCI engine also has disadvantages. Probably the most serious complication is the need to use two separate injections, as well as their programming and accurate timing of the injections themselves. Also, the use of two fuel circuits means an increase in production costs. Also, these engines have so far been operated only at constant speed, which is disadvantageous for vehicles of all categories when driving in real traffic conditions, where the constant speed cannot be kept constant.
Of course, the fact remains that this technology is still in its infancy and further research is needed on the combustion process, or even considering the use of other types and combinations of fuels.
Vehicle manufacturers are also considering the possibility of using the RCCI engine differently than conventional engines are used today. There is speculation about the possibility of combining RCCI technology and plug-in hybrid-like technology, which could open a new door to the development of RCCI engines.

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