International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 7, Issue 6 [Jun 2018] PP: 63-66

Combustion Process Parameters of the Fuel Mixture in Internal Combustion Engines

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ABSTRACT: *In the article the author presented new in his opinion possibilities of improving the operating parameters of internal combustion engines. Points 1-6 present the results of the experiments carried out by the author. In point 6, the author presents the hypotheses regarding new solutions that can improve the parameters of engines used in motor vehicles.*

KEYWORDS - *Spark ignition, ignition spark control, exhaust gas purification, spark current, smoke opacity.*

Date of Submission: 06-06-2018 Date of acceptance: 21-06-2018

I. INTRODUCTION

In modern times, there has been a tendency to limit the operation and manufacturing of cars equipped with internal combustion engines. Such situation results from the greenhouse effect on our planet. All car manufacturers have made an effort to design and manufacture vehicles with the reduced consumption of petroleum fuels as well as low emissions of greenhouse gas and toxic exhaust components into the atmosphere. Constructions of hybrid and fully electric vehicles were made. Hybrid vehicles did not meet the hopes that were put on them, while electric ones have a small range of mileage without recharging the power batteries, production of which requires the use of chemical compounds that are difficult to utilize. The construction of vehicles with internal combustion drive aims at increasing the operation of the spark ignition drive, while diesel vehicles are limited due to the emission of PM 2.5 and larger particles, which are difficult to stop by DPF filters. According to the author, the combustion engines, despite their disadvantages, will not completely disappear from the exploitation market in the next 30 years. Vehicles with internal combustion engines will continue to be operated by special services such as fire brigade, military, emergency services and in situations of inaccessible infrastructure of electrical networks, for example in isolated places. Road transport vehicles for supplying various types of goods, type TIR, will not disappear for a long time. In addition to the presented issues, already manufactured vehicles should be mentioned, as they will continue to be operated until their end-of-mileage and end-of-life. These problems prompted the author to undertake work on improving the process of the internal combustion engine exploitation, because the factory production of combustion engine vehicles will not suddenly be switched to electric motors due to the inertia of the production process and the non-existing electrical infrastructure. These require huge financial outlays and a change in mentality of car users. The process that demands improvement is the combustion and exhaust gases purification.

II. HEADINGS

Controlling the energy of the ignition spark

Currently used solutions for controlling the course of the ignition process of the fuel-air mixture in the combustion chamber are limited to the control of: the ignition advance angle, the composition of the mixture control, the ignition surface. The author of the article recommends to extend this process with additional parameters such as: the ability to influence the energy of the ignition spark igniting the fuel-air mixture. The experiments conducted by the author show that the energy of the ignition spark should be related to the rotational speed of the engine crankshaft and the ignition advance angle [1,2,8].

Average spark current modified system 1.1 mm gap

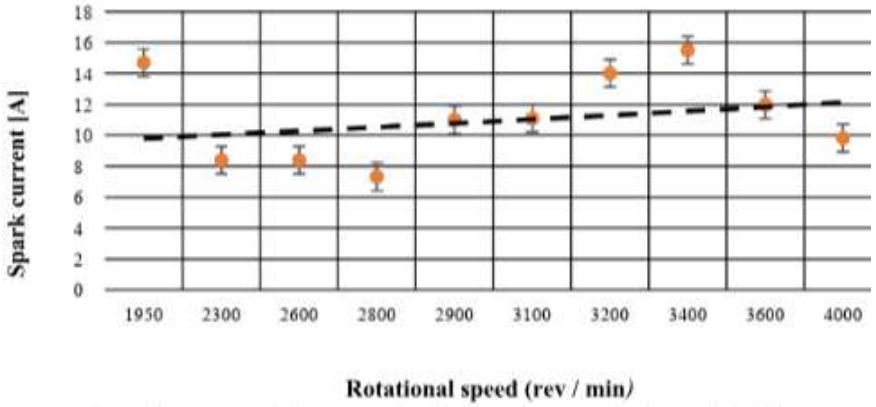

Fig.1. The course of the average ignition spark current in the spark ignition system.

Figure 1 shows the course of the average ignition spark current in the electronic ignition system. In this system, the energy of the ignition spark was increased by modifying the ignition system. The trend line indicates an extremely favourable tendency - the ignition spark current does not decrease as the rotational speed increases. In the ignition system the gap between the spark plug electrodes was increased to 1.1 mm. The tests of the torque course at the dynamometer station of the combustion engine with the classic ignition system were carried out. The torque curve indicates a more favourable course of the torque of the modified ignition system in relation to the factory system, as shown in Figure 2.

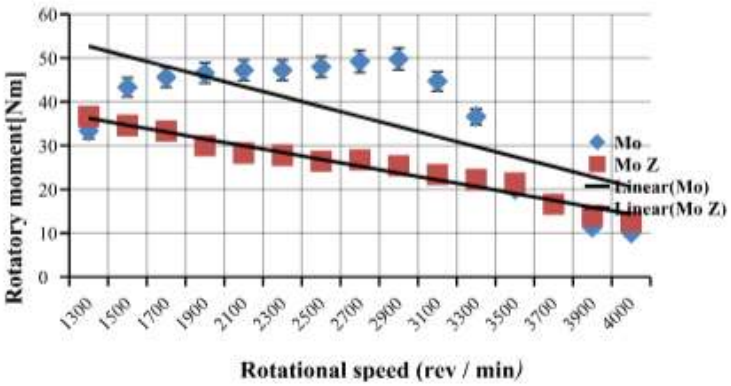

Fig.2. The torque course in the classic ignition system compared to the modified ignition.

2. Possibilities of exhaust purification from solid particles in self-ignition engines.

In presently used particulate filters (DPF), 2.5μm; 5 μm; 10μm solid particles are a great problem of suspended dust. It is a big health issue for people breathing with dusty air. The suspended dusts are so small that they are invisible to the naked eye. At the same time, they penetrate the pulmonary alveoli and enter the human's bloodstream, causing many dangerous diseases. The author of the article investigated the possibilities of purifying car exhausts from PM particles 2.5 μm and larger. The results of the tests are presented in Table 1.

Table 1

Type of exhaust system	The average value of the opacity ratio K [m1] / HRT [%]
Standard system turbo: 1.9 TDI	0,7/26%
System with an additional electric filter, turbo: 1.9 TDI	0,1/4%
Turbo system 1,9 CDI with DPF	0,42/17%
Turbo system 1,9 CDI with DPF and additional electric filter	0,32/13%

Table 1 presents the results of smoke opacity measurement of diesel engine cars. Two types of cars with different exhaust systems were used for the tests. The first car did not have a DPF, the second one was equipped with this filter. Comparative tests of both cars were made, equipping them with the additional prototype of solid particles electric filter, created by the author. The measurement results indicate a significant efficiency of automotive exhaust filtration. The idea of filtering exhausts using electrostatic precipitators is not new. Such filters are used to purify exhaust gases from factory chimneys. The disadvantage of industrial electro filters is the large dimension of these filters. The author of the article tried to adapt existing construction solutions for the car exhaust purification [2,7,8].

3.The improvement of the spark plugs electrical parameters.

Currently used spark plugs have certain electrical parameters. The author of the article carried out an experiment based on changing the electric capacity of the spark plug. Before the flashover, all capacities must accumulate an electric charge, that is recharge. This process delays the spark's flashover by several percent in relation to the entire spark-over process. The results of the research are presented below.

Fig.3. The course of voltage on the spark plug capacity for n = 3600 (rev / min). Figure a/ shows a plug with a larger capacity, b/ with a reduced capacity.

The charging process of the spark plug capacity runs in front of the needle voltage. As the rotational speed of the crankshaft increases, the charging time is reduced, corresponding to the rotational speed related to the time of generating the ignition spark, that is discharging the spark plug capacity. The time is reduced from 50 to 35 microseconds, respectively. The charging voltage of the capacitance varies from 400 to 300 V. This is related to the increase in ionization of the charge, which consists of the ions remaining after the previous combustion process.

The parameters of the spark plug system also affect the process of charging the spark plug capacity. The most important of them is the resistance - affecting the current. The resistance between the spark plug electrodes changes with the engine speed and load. This is due to the change in the composition of the mixture and the λ coefficient as well as the content of ions from the previous ignition. Undoubtedly, the gap between the spark plug electrodes affects the capacity of the spark plug. The process of charging the spark plug is similar to charging the capacitor. In this case a fuel-air mixture acts as a dielectric. Its properties change with the composition of the mixture, the temperature in the combustion chamber and the content of ionized fuel and air particles. In the conventional plug, the spark discharge proceeds in the initial phase in a manner invisible to the human eye. This is called capacitive discharge.

In this discharge phase, the capacity of the ignition circuit, which consists of the capacitance of the high voltage wires, the ignition coil and the spark plug, is charged. These capacities altogether reach the value of 10-10 F
[3, 2,4,8].

4. Other possibilities to improve the combustion process in car engines.

In performance and sports vehicles, the process of combusting the fuel mixture is modified by changing the atmosphere in which combustion takes place. Such a situation consists in adding mixture N2O nitrous oxide to the combustion. This gas contains two times more oxygen than atmospheric air. The addition of nitrous oxide increases the engine power and torque. The NOS systems /nitrous oxide system/ are based on this effect. According to the author, research should be undertaken to change the composition of air-fuel mixture subjected to combustion in the combustion chamber, taking into account the emission of toxic exhaust components into the atmosphere. For example, in currently used fuel systems, the source of unburned hydrocarbons and carbon monoxide is the regulation circuit λ. In the phase of enriching the mixture, this circuit causes incomplete combustion and emission of carbon monoxide, while in the phase of depleting the mixture it causes the emission of solid particles and soot.

Perhaps a change in the composition of the gas that dilutes the sprayed fuel will have a positive effect on the process itself and on the exhaust emissions. It could be possible to abandon the circuit λ and simplify the construction of mechanisms controlling the operation of the engine after changing the composition of fuel mixture with diluting factor. H2O2 hydrogen peroxide can be another promising addition to the combustion chamber [5,6,7,8].

III. SUMMARY AND CONCLUSIONS

In the materials presented above, the author of the article presented, in chapters 1 to 5, new possibilities of improving and controlling the combustion process of combustible cargo in the combustion chamber of internal combustion engines. These considerations have been confirmed to a limited extent. Some of the presented materials have been confirmed by appropriate experiments, the other considerations presented in chapter 6 contain hypotheses, true in the author's opinion. All changes and improvements require further research and should be subordinated to the requirements of the modern ecology and applicable legal norms 1,2/3//6/7] .

REFERENCES

[1]. Urbanowicz M. Patent application titled: Spark plug with increased spark surface, P 401508.

[2]. Urbanowicz M. The course of the spark plug charging process before the spark-over. Moscow State University of Technology "Stankin" Moscow 2014.

[3]. Urbanowicz M.: Shaping the external characteristics of the combustion engine by changing the electrical parameters of the ignition system. BUSES 10/2013.

[4]. Urbanowicz M .: Investigation on a battery-operated ignition system with variable ignition coil transmission: Motor Vehicle Operation Department Publishing, Szczecin University of Technology Publishing. Issue No. 14, Szczecin 2006

[5]. Urbanowicz M .: Influence of selected internal parameters on the operation of the battery ignition system: Motor Vehicle Operation Department, Szczecin University of Technology Publishing. Issue No. 12, Szczecin 2004.

[6]. Urbanowicz M .: Investigation on a battery-operated ignition system with variable ignition coil transmission: Motor Vehicle Operation Department, Szczecin University of Technology Publishing. Issue No. 14, Szczecin 2006.

[7]. Urbanowicz M .: Purification of car exhaust fumes using an electric field: PROBLEMS OF APPLIED SCIENCES, volume 5. Szczecin University of Technology and Economics. Szczecin 2016.

[8]. Urbanowicz M .: Patent: 218399. Polish Patent Office 2015.

[9]. Improvement of motor properties of gasoline engines. Monograph,. ECOLOGY OF MANUFACTURING: Gorzów - Poznań 2015. (co-author J. Mysłowski).

Miroslaw Urbanowicz." Combustion Process Parameters of the Fuel Mixture in Internal Combustion Engines" International Journal of Engineering Inventions, vol. 07, no. 06, 2018, pp. 63–66.