

Car Spark Plugs BUGAETS

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The role of the car spark plugs

The spark plug is a “passive fire starter” generating with a spark single point heat source for ignition of the gas mixture

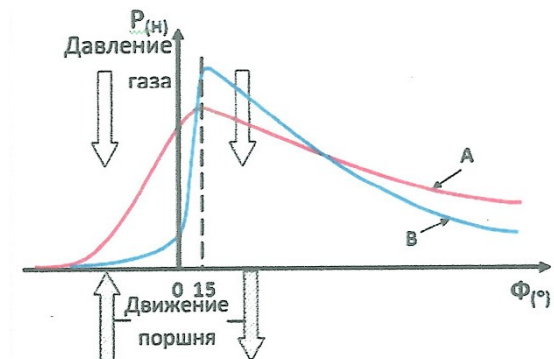
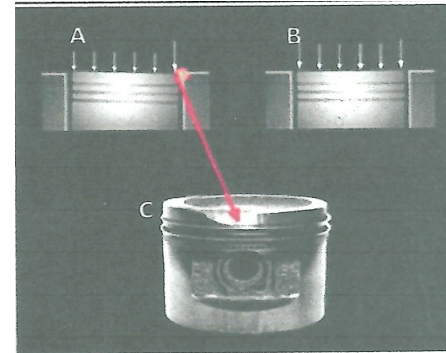
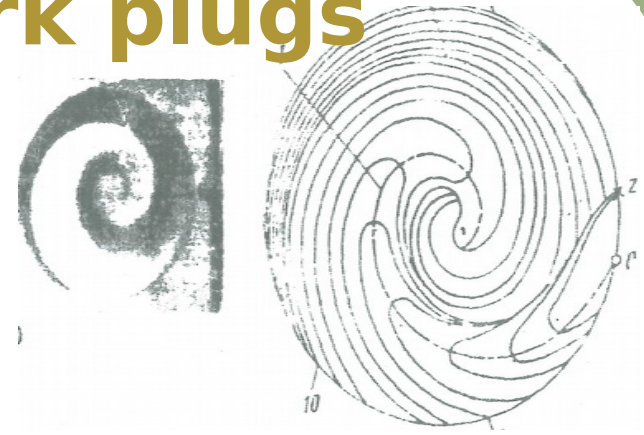
2 phase combustion process:

- 1) Initially the flame is being developed in the format of 3-D helix line up to the center
- 2) Then the flame front symmetrically disperses around and above

End result: (a) the combustion of the mixture terminates at one corner of the compression chamber with ultrasonic speed;
(b) the combustion of the mixture lasts 3 times longer than the minimum reserve

After effects:

- The piston running into a cyclic path in the cylinder and as a result the decrease of the torsion torque until complete engine shut-down
- Inhibitory effect due to back up pressure on the piston **in the compression phase**
- With speed increase in the vehicle the fuel consumption exponentially increases

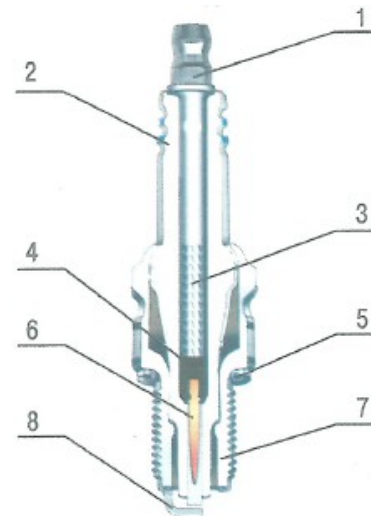
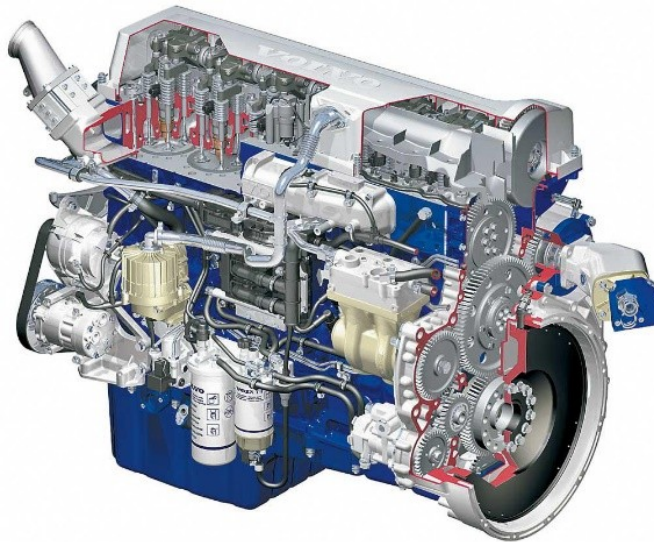


The configuration of the car spark plugs

Brief history...

Since 1830 the car spark plug (CSP) is an integral feature of the petrol & gas combustion engines

Common car spark plug is a “passive fire starter”



- 1 - contact nut
- 2 - ceramic insulator
- 3 - contact head
- 4 - conductive (or resistive) sealing component
- 5 - seal ring
- 6 - central electrode
- 7 - metal casing
- 8 - side mass electrode

Car spark plugs BUGAETS*

"Active fire starter"

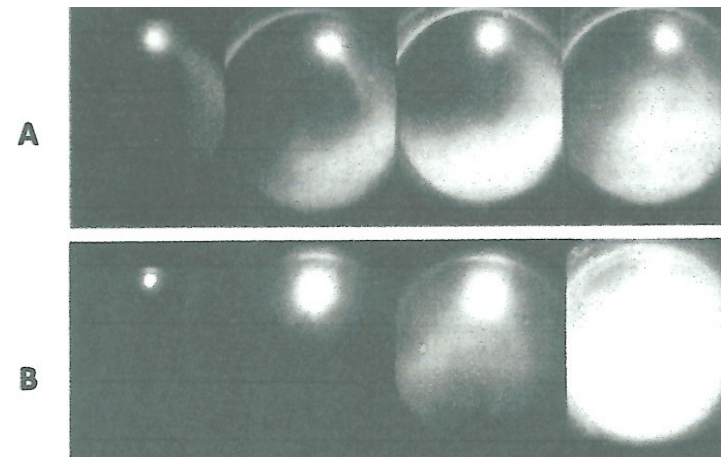
Design

- Has one side mass electrode
- Has **cone-shaped resonator (CR)** from heat-resisting steel with special coating
- **CR consists of:** (a) conic part with the channel for side electrode, and (b) circular-shaped part
- Laser welding done at the boundary of two parts and the frame of the spark plug



Properties

- Formation of special field with useful properties:
 - ✓ the spark gap is increased up to 25% without increase of voltage break-down
 - ✓ there is no flame at HV disruption and spark excitation
 - ✓ the energy of the spray is >200 times than Σ energy of the spark and fuel charge in **CR**
 - ✓ no spark (electrolytic) erosion of the electrodes



Comparison with prototypes

Efficiency increase means replacing “passive” fire starter into “active” fire starter

Pre-combustion

Principle close to CSP Bugaets: well known principle implemented on big stationary gas engines

Deployment: by “MAHLE Powertrain” Company (design “Turbulent Jet Ignition”, 2011).

Design: special micro-sized fuel injectors, actuators and spark plugs

Result: good

Laser

Deployment: by Bosch, Toyota, Denso, Ford, some universities and labs

Result: positive

Drawbacks: laser ignition device are sensitive to vibration, warmup and caking of the optical window. Not applicable to car traffic

Chemical

Principle: based on the principal of chemical disruptive discharge of ionized gas by high voltage electrical field

Deployment: by American Company Federal-Mogul (design “Advanced Corona Ignition System” - ACIS)

Design: system module contains special spark plugs with nickel needle, resonant magnetron, special HV cable, transformer block. $V = 100 \sim 500 \text{ kV}$

Result: positive, status - R&D

The global industry is oriented towards symmetrical and quick burning of the fuel mixture, however suggested methods are overcomplicated

Competitive advantages of the spark plugs Bugaets

Spark plugs Bugaets can substantially improve the characteristics of the car engines:

1. Acceleration capacity -5÷30% higher due to increase of the torsion torque, especially with increase of the vehicle weight

2. Efficiency - obtained also due to increase of the drive torque, especially at forced working and high engine speed (rpm)

- at V = 90 km/h on 10÷15%
- at V = 120 km/h on 30%
- at V = 150 km/h on 50%

3. Ecological performance - increased due to leaner fuel ratio during idle running and due to economical and quick burning of the fuel mix (CO almost zero, CH less 5 times, NOx less 2 times)

4. Flexibility - increased due to expansion of the operation range of all gears

- at 2-nd gear up to 100-120 km/h
- starting from standstill at 5th gear without accelerator pedal and acceleration of the vehicle up to 40-50 km/h

5. Max. speed -20% increase obtained

6. Engine start-up at low temperature - due to spark plug survival at heavy depletion of the fuel mix. Provides for stable startup at - 45 C°

7. Engine warmup - substantially decreased due to efficiency factor and mitigation of the mechanical losses

8. Normal cool engine tie - due to absence of the blocking effect of the piston given the maximum expansion gap between the piston and the cylinder

9. Engine lifetime - substantially increased due to integral effect of above mentioned parameters being improved

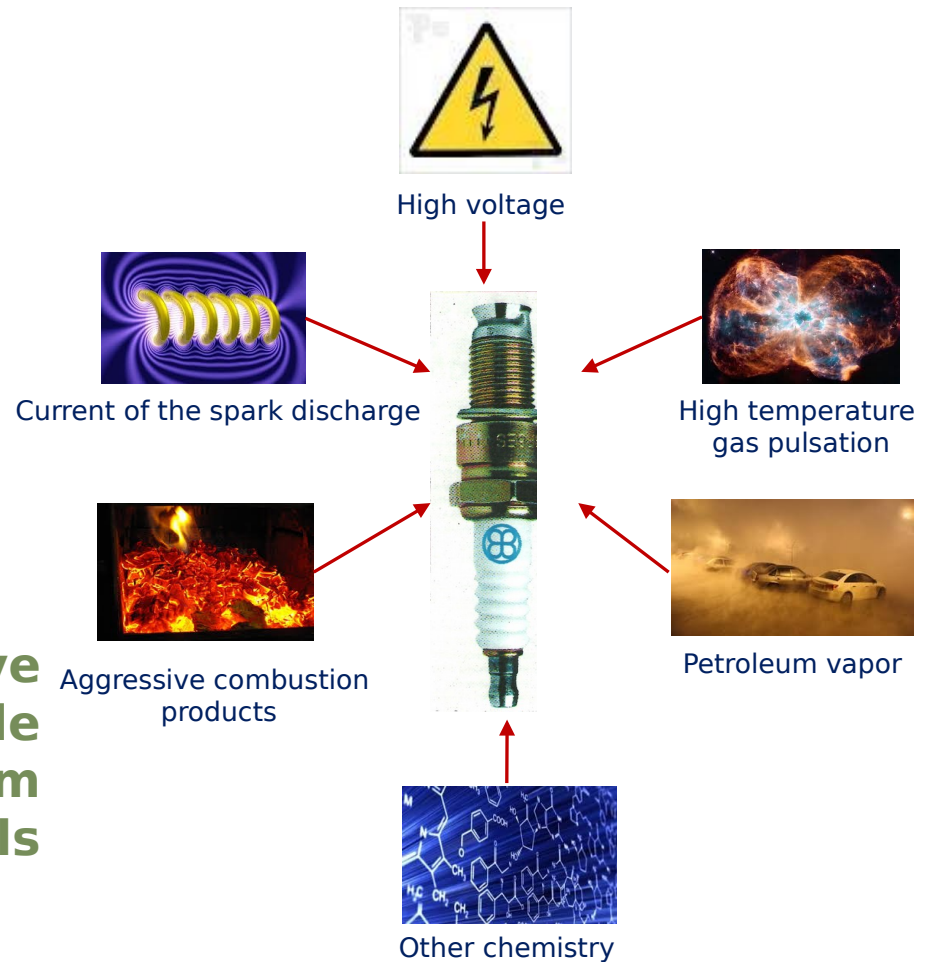
CSP Bugaets lifetime

The car spark plug is the most stressed unit in the engine. Thus, its lifetime is one of the key features

Standard car spark plug: lifetime **20 000 ÷ 100 000 km** depending on the amount of the side electrode (from 1 to 4) and availability of the tip made of precious metals (platinum, iridium)

Lifetime SP Bugaets = 200 000 km

SP BUGAETS does not have electro-erosion on the side electrode and is free from application of precious metals on the electrodes



Pros & cons of the project

	Advantages	Disadvantages
P o s i b i l i t i e s	<ul style="list-style-type: none"> • Simple cheap spark plugs Bugaets substantially improve all characteristics of the engine and the vehicle. We pay small money and get a higher-class vehicle - it is worth selling the effect rather than metallic detail with ceramics • As per its design, the spark plugs Bugaets are compatible with the ordinary spark plugs. No assembly bottlenecks • When adjusting the ignition system to the new spark plug, a substantial further improvement of the engine parameters can be seen (in co-work with the engine plant) • In continuation to the car spark plug idea and modernization of the engine, a new engine can be obtained far beyond the engines of the competitors 	<ul style="list-style-type: none"> • So far the automobile industry showed no interest to the car spark plugs. Hypothetic reasons: conservatism, false engine theory and unwillingness of mid management to move in this direction. Main argument: "Spark plugs do not matter in the engines". The idea can not reach the top management of the carmakers • Things are more simple on the after market. However there were cases of small effect after application of the SP Bugaets. Reason is in the system pattern: there would be some important deficiency in a complicated system of the engine which would determine the general low level of the system. The effect of the spark plugs was restored after elimination of the defect
C h a l l e n g e s	<ul style="list-style-type: none"> • Attempt to obtain imitative patents in the Russia Federation and piracy production of the spark plugs 	<ul style="list-style-type: none"> • Negative economic situation, absence of free cash for investments into production and marketing of the car spark plugs

About the Designer

Eugeny Bugaets, D. Sc. in engineering, author of more than 90 scientific works, including 50 inventions and patents

Graduated from Kaunass Institute of Technology, faculty of radio electronics

Worked as leading engineer in Vilnius R&D Institute of radio metrical devices

Developed and implemented 5 impulse generators

Member of the Innovation Council under the Chairman of the Council of Ministers of the RSFSR (had Deputy-Minister status)

Discovered “Genuine systems” and has being putting it into tests for 20 years