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«Promising methods for strengthening piston aluminum alloys of heat engines»

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Problem statement

- Improving the performance of automotive diesels in the face of increasing demand in the automotive industry is one of the most urgent tasks. This task is solved both by improving the engine workflow and by optimizing the main components and parts.
- The possibility of improving the working process of a piston engine by increasing gas pressures and thermal loads on parts is largely related to the design of the piston, the technologies and materials used in its production. This is especially true when using alternative fuels, in particular natural gas, when the temperature in the combustion chamber increases significantly .
- When the engine is running, especially under high temperatures and pressures, special attention is paid to the design of the piston, which determines the main performance of the engine.
- The piston must have sufficient strength characteristics that provide the necessary reliability and durability in conditions of high dynamic, mechanical and thermal loads. At the same time, it must have a low mass, high wear resistance of the contact surfaces, low friction losses with minimal mounting gaps in the cylinder, optimal thermal conductivity and a low coefficient of thermal expansion.

Solution methods

- Micro-arc oxidation (MDO) is a relatively new type of surface treatment and hardening of metal materials, originating from traditional anodizing, and therefore refers to electrochemical processes. Micro-arc oxidation makes it possible to obtain multifunctional coatings with a unique set of properties, including wear-resistant, corrosion-resistant, heat-resistant, electrical insulation and decorative coatings.
- A distinctive feature of MDO is the participation in the process of coating formation of surface micro-discharges, which have a very significant and specific effect on the formed coating, as a result of which the composition and structure of the resulting oxide layers differ significantly, and the properties are significantly increased compared to conventional anode films. Other positive features of the MDO process are its environmental friendliness, as well as the absence of the need for careful pre-surface preparation at the beginning of the process chain and the use of refrigeration equipment to obtain relatively thick coatings.
- MDO oxidation of the surfaces of products made of metals of the valve group (aluminum, titanium, etc.) makes it possible to form a strong oxide coating on them with a hardness close to corundum, good adhesion, low porosity and high anti-corrosion properties. This is especially true for parts of limited mass, such as internal combustion engine pistons, turbine blades, various sealing assemblies, and so on. It is also used for parts that work under severe conditions of high temperatures, aggressive media and high mechanical loads. MDO contributes to the formation of high temperature modifications of Al_2O_3 with high microhardness

Conclusions

Results, implementation

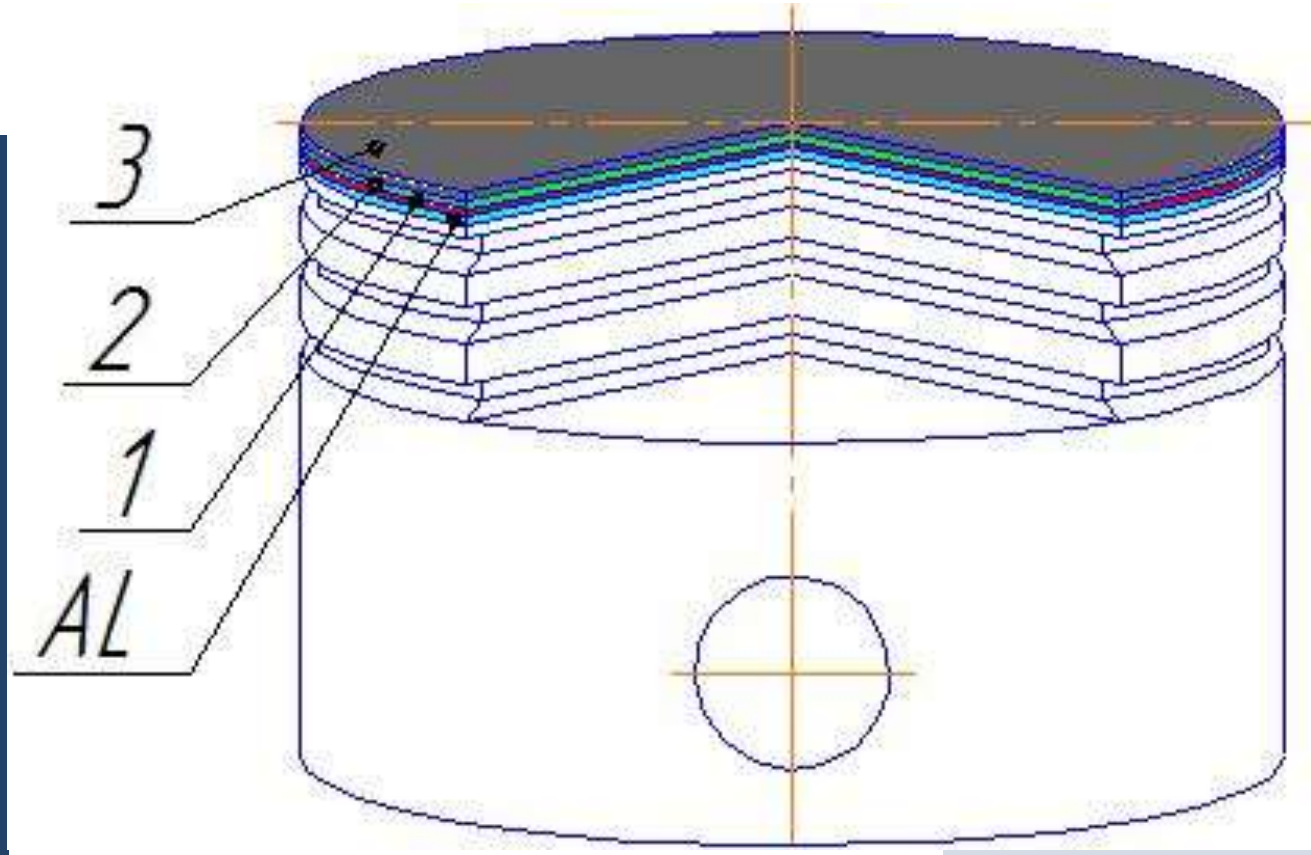

Figure 1. Structure of MDO coatings on the piston: 1 - thin transition layer; 2 - main working layer; 3 - outer process layer

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