METAL SURFACE MODIFICATION BY THE JOINT IMPACT OF IONIZED DETONATION PRODUCTS STREAM AND ELECTRIC DISCHARGE

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The report presents the results of studies of changes in the structure, phase composition, mechanical and operational properties of the surface of metal products due to the impact of pulsed flow of ionized gas and pulsed electric discharge. In the prototype of the industrial installation detonation products of gas mixture of propane, butane, oxygen, nitrogen are additionally heated up by the discharge of the 1000 microfarad capacity with voltage of up to 3500 V. Pulsed flow of ionized gas having temperature of up to 12000 K together with the pulsed electric discharge having a current density of up to 10000 A/cm² produce a manifold impact on the surface including the thermal impact with power density of up to $10^7$ W/cm², chemical impact, electromagnetic impact (strength of magnetic field up to $4 \times 10^5$ A/m) and mechanical impact. Pulse duration is up to $10^{-3}$ s, pulse frequency is up to 5 Hz. Modification of the surface layer takes place at the depth of up to 60 microns and includs the following processes: (1) recrystallization with the formation of nano-crystalline and submicron structures; (2) alloying of the surface with the elements present in the ionized gas flow (W, Mo, Co, Al, Cu, Ti, N₂); and (3) chemical reactions with the formation of metal carbides (WC, W₂C, W₃Co₃C) and intermetallic compounds (Co₇W₆, Co₃W, Fe₇Mo₆). The proposed method of surfaces modifying is highly effective for tool steels, hard alloys, high-strength cast iron (the wear resistance of tool steels increases from 2 to 4 times). The metod is energy saving and is characterized by high productivity (the productivity of the prototype is 0.2 m²/h, electric power 20 kW, propane+butane consumption is 0.35 m³/h, total consumption of gases is 3 m³/h). Experiments with different metal surfaces (including steels and alloys) have been conducted to produce relevant statistics for working out industrial technological procedures.

Keywords
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