V. Udovichenko, H. Miroshnyk, E.Chevychelova
Kharkiv National Automobile and Highway University, Kharkiv

USING LASER PROCESSING FOR IMPROVING WEAR RESISTANCE OF PISTON RINGS OF FIRE FIGHTING VEHICLES

The efficiency of the operation of fire fighting vehicles largely depends on the effective operation of cylinder-piston group parts, among which great attention is always paid to the piston rings. Different operating conditions of modern piston rings require a differential approach to the choice of materials and their composition to improve durability considering cost-effectiveness.

The advanced methods for strengthening and restoration of machine parts, in particular the cylinder-piston group parts, include high-temperature coating methods, namely plasma, flame and electric arc spraying.

The piston rings of cylinder-piston group parts operate under stress conditions, characterized by high temperatures (up to 19000 °C of the burning mixture, up to 6000 °C at the liner surface and up to 450 °C at the piston skirt), pressures (up to 15 MPa) and extremely unfavourable friction behaviour from liquid to dry one under reciprocating motion [1, p. 15].

High-power CO2 lasers with continuous wave operation offer wide possibilities for surface hardening of machine and tool parts and provide the possibility of changing power and time of exposure over a wide range.

To increase the efficiency of laser hardening, special coatings, which are good at absorbing radiation energy, are applied over the surfaces being processed.

At present, laser heat treatment is applied to ferritic malleable iron with low initial hardness. It takes 15 minutes to create a hardened 0.25−0.63 mm thick layer by laser treatment of cast iron liners and bushes of diesel cylinders. In the future, the duration of the treatment is expected to be shortened by 1.5 times [2, p. 36].

The piston rings of KrAZ−5401NE fire truck with the all-wheel-drive chassis (4x4) have been investigated. These new trucks are equipped with turbocharged diesel engines, whose power is 330 hp. The maximum speed is 85 km/h. The vacuum suction system is an independent semi-automatic system (HBE −24). The machine is equipped with a centrifugal fire pumps (PN−60B−PP) with a supply of 60 liters per second and a pressure of 100 meters. The total weight of the machine is 19 tons.

In the analysed range of laser treatment modes, the layers are formed in the irradiated cast iron along with the emersion of zones tempered from the molten state.

The surface of the cast iron melts over the entire contact area with the beam at an irradiation speed of 5.4 mm/s, partly at irradiation speeds of 6.5; 7.6 mm/s; at a speed of 11 mm/s only the hardening of the surface layer is observed. At this, the depth of the layer decreases with the increase of the irradiation speed according to the parabolic law. At an irradiation speed of 11 mm/s it is 0.5 mm, at 5.4 mm/s it is 1.3 mm.

The above analysis of the structure and properties of the irradiated cast iron layers shows that both melting and hardening can significantly strengthen the surface layer.

References

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