Crankshaft - one of the major parts of the crank mechanism, which, together with the other parts are the life of the internal combustion engine. The service life of the crankshaft depends on the conditions of work and wear.

Car parts exposed to almost all kinds of wear. The crankshaft runs in plain pin main and connecting rod journals and with bearing grease. Wear on the shaft by a number of specific factors:

- alternating contact load;
- regularly changing the contact area as part of its deterioration;
- changing conditions lubrication details as changing its shape;
- load, speed and thermal conditions of the details;
- fluctuations in physical and chemical properties of lubricants.

Combination of these factors causes mostly mechanical wear of the crankshaft.

Abrasive (mechanical) wear is the result of cutting or scratching of the solid particles in free or secured status.

In the operation of the engine as a result of uneven wear, short-term overload, block displacement of supports because of the aging of the metal and other factors there are situations in which the shaft is operated under overload. In the course of repeated cyclic loading and deformation micro volumes of the metal surface layer in its structure accumulated fatigue damage, leading to fatigue spalling most stressed zones details. Such zones in automotive engine crankshafts are the central part of the main and connecting rod journals in maslopodyaschih holes.

Thus, cranks the engine to work in a predominantly fatigue and abrasive wear surfaces necks, have to meet strict requirements to comply with the geometric dimensions. Consequently, the service life of the crankshaft depends on the resistance to fatigue and wear resistance of the surface spalling main and connecting rod journals.

Worn crankshafts perezhivayut for repairs up to six times. Beginning with the third oversize wear indigenous necks significantly increased compared to the new, because of the reduction of surface hardness, so they must be re-tempered from the second oversize. But here there are difficulties. As in the case of induction hardening occur strain trudnoustranyayemoye the repair, this method is not applicable. Laser thermostrengthening enhances endurance crankshaft journals approximately two-fold compared with neuprochnennymi without deformation. However, due to the cost and complexity of the laser equipment, this process also found use in repair shops. Therefore, the application of technology repairing worn journals crank engine is promising and urgent task. In addition, the restoration of worn parts in the repair system of machines is environmental and resource production. To make, for example, one of the crankshaft of the engine with a displacement of 4.8 liters. consume 57 kg of metal, 183 MJ of energy, the mass of waste is then equal to 2.5 kg. When you restore these values ??have a value of about 20 times smaller, respectively, 2.6 kg, 9.5 kg and 0.12 MJ.

Among a variety of processes restore worn parts about 85% of the recovered journals of crankshafts of all engines is accomplished by the use of welding and surfacing processes. A common shortcoming of the different ways of surfacing is a significant thermal effect of the arc on the workpiece, followed by its melting, the occurrence of residual stress, deformation, cracks, and, as a result, reduced the fatigue resistance by 50 ÷ 70%, as well as wear resistance compared to the new parts. For weld metal is characterized by large variations mechanical properties. These drawbacks have stimulated the development of gas-thermal spraying methods for recovery of crankshafts.

The idea of ??treating porous structures in the details of friction first patented in France in 1870, but development was only with the advent and development of ways to form a controlled pore structure. The presence of pores in the coating not only improves wear resistance, but also increases the time until the metal seizure crankshaft journals and bearings after stopping the oil supply. Porous coating on the crankshaft must withstand high loads while maintaining its structure and performance.

Small amounts of heated or molten particles \( d_n = 30-150 \text{ mm} \), high degree of deformation (spreading) at impact; micron thicknesses and extremely high temperature gradient \( \sim 10^5 \text{ K/s} \) in heat exchange determine deep hypothermia molten particles that is known to lead to a huge number of nucleation sites in the melt and the simultaneous hardening of the entire mass. All this leads to a distortion of the crystal lattice, the emergence of a large number of defects in it. The large number of defects in the crystal lattice impedes the motion of dislocations, fixes them.

Currently, the installation of high-speed flame spraying are well represented in the market, however, most of them involve the use as a material for coating powders only (most of all wear coatings applied by spraying high, falls on hard alloys based on tungsten carbide). The use of expensive powders significantly increases the already considerable cost of the coating. In the financial crisis forced the company to reduce its costs, including to conduct repair work. The use of filler powder wires alloyed iron-based alloys, can significantly reduce the cost of the coating, without much loss in wear resistance (to date, the cost of powder materials based on tungsten carbide on the order exceeds the value of most of cored wires).

So, in the modern setting "Tenhikord Top Jette / 2" do we get wear-resistant coatings sprayed cored wires. Figure 1 shows the process of applying geometry reconstruction crank pin crankshaft.
Recovery engine crankshafts

Fig. 1. Geometry restoration crankpin.

In the development of coating technology have been carried out comprehensive studies of coatings obtained from cost-alloy cored wire based on iron - PP-PM-6.

In the investigation of the microstructure of the coating (Fig. 2.), Spherical particles were found. All the particles were large plastic deformation, so the boundaries between particles almost no pores, the particles are flush with each other. This results in a high cohesive and adhesive strength of the coating.

Fig. 2. The microstructure of the coating of PP-PM-6

The phase composition revealed the presence of the coating type spinels $\text{FeCr}_2\text{O}_4$ and carbides such as $\text{Fe}_2\text{C}$, $\text{Cr}_3\text{C}_2$, which largely determine the wear resistance of the coating. The high rate of crystallization of steel particles in the process of forming the deposited layer and the slow rate of cooling in the range of martensitic and bainitic transformations during cooling coatings provide stabilization of austenite. Most of it goes to martensite even during deposition since high degrees of deformation during the application of subsequent layers.

The study was conducted on the durability of the testing samples for wear by friction coatings are not rigidly attached to the abrasive particles. The study found that a coating of PP-PM-6, obtained in optimal conditions spraying has high durability. Test the durability in abrasive wear by friction on fixed abrasive also showed high durability coatings PP-PM-6. In relative terms, wear-resistant coating approximately twice the durability of steel sample standard. The average microhardness of the samples after the wear reaches $11$ GPa, while the same value for the uncoated samples -6 GPa.

Technology of high flame (HVOF) spraying process is stable and provides coatings with certain characteristics (for example, the hardness of the coating is in the range $48 \div 52$ HRC). This allows you to effectively apply the coatings obtained by this method, for the renovation and strengthening of machine parts.

Thus, we are able to restore the crankshafts of different equipment with diesel engines by applying a coating of low-alloy steel plated cored wire.

Currently successfully used for over a hundred rehabilitated so crankshafts of different sizes, from "Lada" to modern trucks imported.