PROBLEMS OF INCREASING THE DURABILITY OF CRANKSHAFTS OF TRUCKS

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Annotation. The article deals with the problems of increasing the strength of the crankshaft of an automobile engine and their repair processes by chemical methods.
Keywords: engine, crankshaft, transport, inertia, cylinder, element

The automotive industry - one of the leading branches of the machine-building complex-is a system-forming element of the economy that affects the level and quality of life. The development of road freight transport has a significant impact on the activities of all sectors of the country's economy, providing transportation in the processing industry, agriculture, trade and other industries.

Analysis of crankshaft defects (Fig.1.) works in the 8-cylinder V - shaped engine MAN and its modifications, which are installed on MAN trucks.

Engine power is 154 kW (210 HP) at the rated speed of the crankshaft 2600 min-1; maximum torque on the crankshaft 637 N-m (65kg-m) at the speed of the crankshaft 1600-1800 min-1 [2, 1].

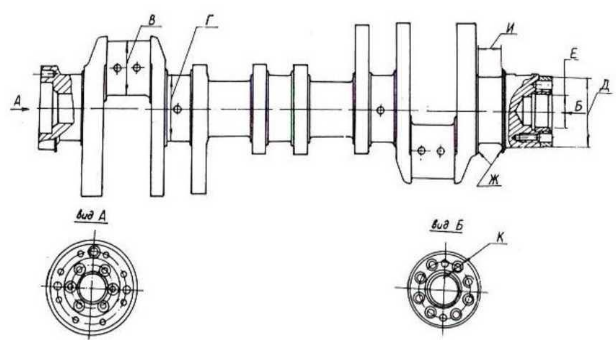

Fig. 1. The crankshaft of the engine MAN

The crankshaft is one of the main parts of the engine that determines its life, the most complex in terms of design and the most stressful part that receives periodic loads from gas pressure forces, inertia forces and their moments.

The action of these forces and moments leads to the appearance of significant twisting, bending and stretching - compression stresses in the crankshaft material. In addition, periodically changing moments cause torsional vibrations of the shaft, which create additional torsional stresses.

Table 1.

Chemical composition of steel 42 HMFA

Name	Content %
carbon	0.40-0.45
silicon	0.27-0.37
manganese	0.5-0.8
vannadium	0.08-0.12
chrome	1,0-1,8
molybdenum	0.35-0.45
sulfur	0.01-0.035
phosphorus	0.025
copper	0.35
Nickel	0.3
iron	the rest

The properties of the steel from which the crankshaft blank is formed, studied on the samples, must meet the requirements of the manufacturer, which are presented in table.2 [1].

Blank crankshafts are forged from steel 42 HMFA TU 14-1-1296-75. The material for the manufacture of crankshafts is supplied not thermally processed in bars (HB 255-277), the chemical composition is shown in table 1/

The crankshaft has five main and four connecting rods. The main and connecting rod necks of the crankshafts are hardened by HRC HDPE (52 ... 62) [2].

Table 2

Name of the parameter	Grain direction	
	longitudinal	cross
Time resistance, MPa	880	880
Yield strength, MPa	730	730
Elongation, %	12	7
The relative narrowing,%	55	35
Impact strength, MPa	100	60
The fatigue limit in bending, MPa	360	320

The nominal and repair dimensions of the crankshaft necks and other indicators of the geometric and surface properties of the new and restored crankshafts are presented in 3.

Defects of crankshafts and their repeatability coefficients are shown in table.4

Parameter names	parameter values	
	new	restored
1. Diameter of the root necks, mm 1st repair size 2nd repair size 3rd repair size 4th repair size	95,0-0,015	95.0- 0,015 94.5 - 0.015 94.0- 0,015 93.5- 0,01593.0- 0,015
2. The roughness of the cylindrical part, mkm	0,20	0,16
3. Width of the root necks, mm 1.2.3.4.5 1st repair size 1.2.3.4.5	36-0,17 36,5 +0,05	36 +0,20 -0,17 36,2 ± 0,05 36,5 + 0,05
4. Radius of the root necks, mm 1,2,3,4,5	3± 0,15	3+0,15
5. Diameter of connecting rod necks: 1st repair size 2nd repair size 3rd repair size 4th repair size	80-0, 015	80-0, 015 79.5 - 0.013 79.0 -0.013 78.0-0.013
6. The roughness of the cylindrical part, mm	0,20	0,16
7. The width of the crank pins	67±0,12	67+0,22
8. The radius of the fillets	4+0,15	4+0,15
9. The width of the cheeks, mm 1 and 8 2,3,.4,5. 6,7 Weight, kg	36,3-0,4 27.4 26.6 69. 5	

The analysis of the technical condition of the crankshafts received with MAN engines for major repairs was studied at the" AUTO-MED " MCHJ.

The service life of the crankshaft is characterized by the possible number of recovery necks for the repair size.

The main reason for the rejection of crankshafts are bulging necks, cracks on them (Fig. 2.) and deformation (runout) of the crankshaft with minor wear of the necks themselves, which are in the size tolerance field. When scoring on the journals of crankshafts increases the probability of formation on them of cracks and deformation, the statistical link between fracturing and the formation of the runout of the crankshaft is weak (5=4), and the relationship between the scoring on shaft journals and the crankshaft runout is very strong (5 =30) [3].

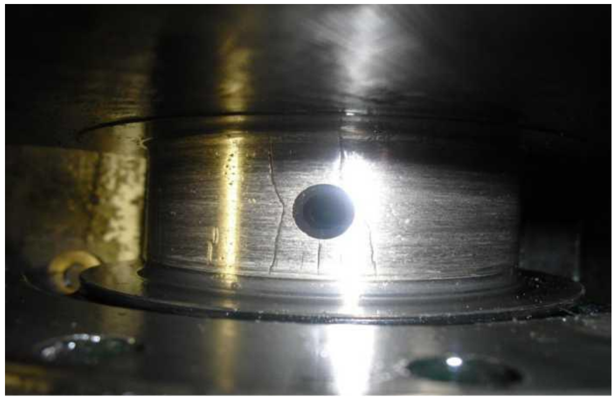

Fig. 2. Burrs and cracks on the shaft journal

As the crankshaft deflection increases, so does the number of non-serviceable shafts and their rejection.

If the crankshaft deflection exceeds 0.9 mm, it is not advisable to restore it due to the formation of fatigue cracks in it, while up to 90% of shafts with such a deflection are subject to rejection.

Another factor that characterizes the durability of the crankshaft is the resistance to fatigue loads.

Despite the different nature of the external manifestation of failures due to wear and fatigue, they are based on the same physical processes described by the laws of fracture mechanics, according to which most types of wear are fatigue [4].

The resistance to fatigue loads is largely influenced by the uniformity of the product material and the quality of its manufacture.

In the process of manufacturing crankshafts, when forming the billet (stamping) and subsequent mechanical processing, their rejection is about 3%, most of which have cracks, mainly at the stamp joint [5].

The formation of cracks on the crankshaft necks during manufacture significantly reduces their operational life. In addition, the durability of KV restored by re-grinding for the repair size depends on the accuracy of the geometric and coordinate dimensions. Non-compliance of gaps with technical conditions (TU) in the "neck-liner" coupling, changes in the macro geometry and roughness of the necks lead to a deterioration of the interface working conditions, which causes an intensive increase in the interface bulge during running-in [6].

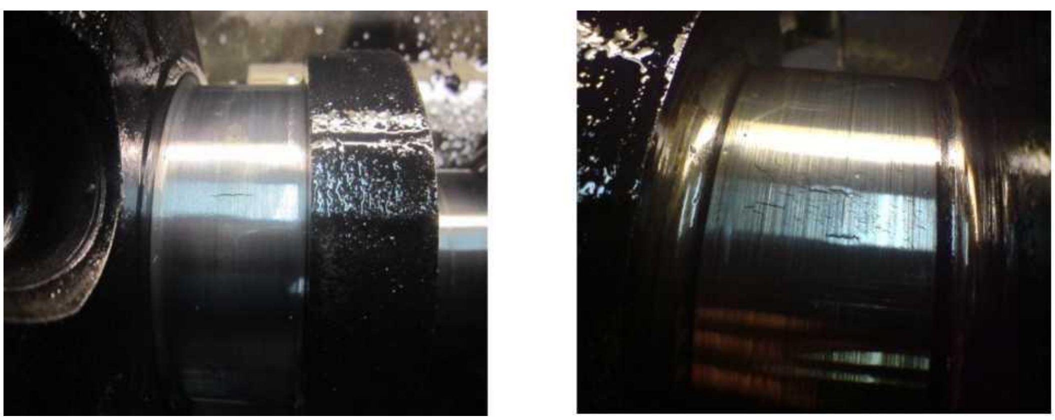

Fig. 3. Fatigue cracks on the shaft neck

Defects in the crankshafts that appear during operation show that the failure of the crankshafts in most cases occurs:

"because of the bad necks;

- with the dominant influence of bending in the crank plane;

- due to its destruction due to the constant growth of deformations and cracks and the gradual accumulation of local defects. Thus, to increase the durability of crankshafts, it is necessary to improve the lubrication system of their bearings, especially connecting rods, to control the shape of the coupling, to remove the deflection of the crankshaft. Improved technologies for restoring engine elements:

- electrolytic deposition of iron-Nickel coatings under conditions of controlled rarefaction over the electrolyte mirror; I want to get uniform coating precipitation with less allowance for mechanical processing and uniform physical and mechanical properties;

- surfacing metal coating under a layer of flux followed by the creation of a plating copper coating on the necks of the crankshafts, which plays the role of a solid lubricant, which allows you to prevent teasing necks under critical lubrication conditions.

This coating is recommended to be applied not only when restoring the crankshafts, but also when replacing liners or when reshaping the crankshaft necks to fit the repair size, during current and major engine repairs.

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