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Analysis of an unusual crankshaft failure

Changli Wang [a,*], Chengjie Zhao [a], Deping Wang [b]

[a] Analysis and Measurement Center, Harbin Institute of Technology, Heilongjiang, Harbin 150001, China
[b] Harbin Science and Technology University, Heilongjiang, Harbin, 150001, China

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Abstract

A crankshaft cracked in a strange manner when test running was performed for only 20 min. Four cracks were found on the edge of the oil hole. Using mechanical analysis, microstructure and metallurgy the reason of this event has been revealed. Force of friction caused by improper crankshaft repair and assembling is main factor of the failure. Why friction occurs, how the crack initiates and expands and what the process of failure is were studied.

Keywords: Crankshaft failures; Automotive failures; Bearing failures; Friction; Seizure

1. Introduction

The failure shaft is a new crankshaft; model RD8T, on a bulldozer TCM-175B. After a crankcase repair process it was assembled to the engine and began test running without any loads. An unusual noise arose and the test was stopped automatically 20 min later. Disassembly detection was performed and four cracks were found on the fourth main journal. All of them were located on the edge of oil hole (Fig. 1). The lengths of the cracks were 6–9 mm. Main bush was destroyed seriously (Fig. 2). The copper on inside of bush was almost torn off totally. Only a little copper was stuck on the surface of shaft and bush randomly. The color of the surface of main journal was dim and there were blue and black circle zones crossed with cracks. No other damage can be seen by naked eye.

* Corresponding author.
E-mail address: chlwang@163.com (C. Wang).

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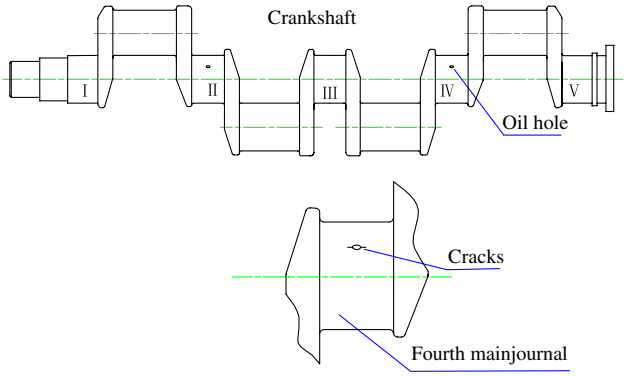

Fig. 1. Schematic illustration of crankshaft and cracks on the fourth main journal.

Fig. 2. Damaged main bush.

2. Chemical analysis

A sample taken from crankshaft was analyzed see Table 1. It is 40CrMnMo alloy. The content of Mn and Mo was little bit lower than general value, but no serious effect on the properties of material can be induced.

3. Metallurgy investigation and hardness test

Two samples were taken from shaft. One is cut through and vertical to the crack for the sake of crack route observation. Another one is made by applying a load to the shaft, leading the crack to expand until totally cracked in order to carry out metallography investigation.

Microhardness tests found that the hardness of hardened layer near the skin of shaft was reduced because of heating (Fig. 3).