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O T T A W A November 13th, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1533.

Examination of a Forged Fork-Type Steel Crankshaft, Part No. 602555.

(Copy No. 6.)

Bureau of Mines
Division of Metallic
Minerals
-
Ore Dressing
and Metallurgical
Laboratories

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
Mines and Geology Branch

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Source of Material and Object of Investigation:

On November 3rd, 1943, Mr. F. E. Hayes, for S. H. Morrow, Inspector-in-Charge, Materials Group, BRITISH AIR COMMISSION, 5-231 General Motors Building, Detroit 2, Michigan, submitted for examination one rough forged fork-type crankshaft, Part No. 602555, in the "as forged" condition. It was requested (letter, File No. D-M6/WE/DA-TPS-12321/8270) that a metallurgical examination be carried out on this forging in order to decide whether there was any evidence of overheating, particularly in the thinnest part of the section. An examination for decarburization was also requested.

It was stated that this forging had been scrapped on account of excessive grinding and was selected at random as a routine check on the firm's forging practice.

Macro-Examination:

The rough forging, shown in Figure 1, did not show any surface defects and appeared to consist of sound metal.

Figure 1.

FORGING "AS RECEIVED".
(Approximately 3/8 size).

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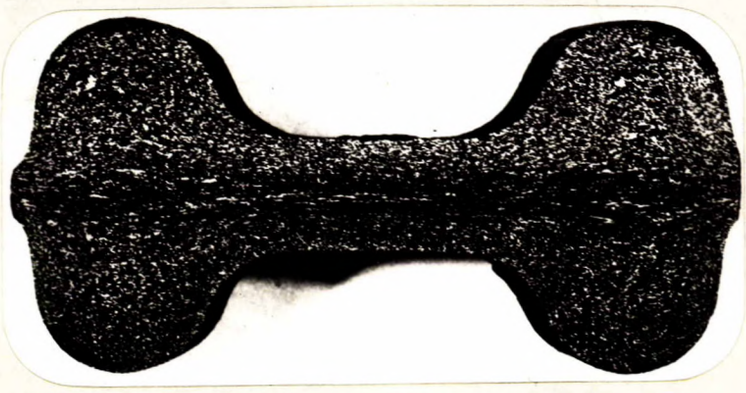
A cross-section of the forging, taken from the middle thin portion of the casting (see Figure 2), was given a rough polish and then macro-etched in a hot solution (160° to 180° F.) of 50 per cent hydrochloric acid for one hour.

Figure 2.



X2, macro-etched in 50 per cent HCl.

CROSS-SECTION OF FORGING.

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After this treatment the forging showed no evidence of checks or burnt grain boundaries.

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Hardness Tests:

Hardness tests were carried out on the forging by the Brinell method, using a 3,000-kilogram load, and the steel was found to have a Brinell hardness of 235.

Chemical Analysis:

The forging was sampled in a milling machine for chemical analysis. The following results were obtained:

	Specified*	Found
	- Per cent -	
Carbon -	0.35-0.40	0.39
Manganese -	0.60-0.80	0.74
Phosphorus -	0.04 max.	0.017
Sulphur -	0.05 "	0.014
Nickel -	1.65-2.00	1.76
Chromium -	0.60-0.90	0.84
Molybdenum -	0.20-0.30	0.21

* Specification AMS-6412.

Microscopic Examination:

A specimen was cut from the thin section of the casting and was given a metallographic polish. The steel was first examined under the microscope in the unetched condition and found to be fairly clean. It was then etched in a solution of 2 per cent nital and re-examined. Figure 1 is a photomicrograph, at X1000 magnification, showing the etched structure of the steel. The structure is similar to that of drawn martensite. There was no evidence of any burning of the steel and the surface of the material was found to be practically free from decarburization.

(Continued on next page)

(Microscopic Examination, cont'd) -

Figure 3.

X1000, etched in
2 per cent nital.

MICROSTRUCTURE OF STEEL.

Remarks:

The composition of the forging submitted is within the limits specified for this material. The low phosphorus and sulphur contents, together with the cleanliness and soundness of the metal, would indicate that the steel was properly made. The microstructure indicated that the steel had received a quench-and-draw heat treatment, the draw temperature being quite close to the lower critical. There was no evidence found of overheating the steel. The depth of decarburization was so small as to be considered negligible.

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