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OTTAWA November 19th, 1943.

REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1536.

Examination of a Set of Broken Valve Springs for Kermath Seachief IV Marine Engine.

(Copy No. 10.)

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

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
Mines and Geology Branch

O T T A W A   November 19th, 1943.

R E P O R T

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ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1536.

Examination of a Set of Broken Valve Springs
for Kermath Seachief IV Marine Engine.

Origin of Request and Object of Investigation:

On November 6th, 1943, a number of valve springs for the Kermath Seachief IV marine engine were submitted for metallurgical examination, to determine the cause of failure.

An accompanying letter (File No. 975-5-9(AMAE DAI)) from Air Commodore A. L. Johnson, for Chief of the Air Staff, Department of National Defence for Air, Ottawa, Ontario, stated that failure of these springs had been chronic on this engine for some time.

Macroscopic Examination:

The broken springs, as received, were observed to have failed by fatigue. This type of failure is, of course, characteristic of springs.

The surface did not show any evidence of shotblasting.

Chemical Analysis:

		Per cent
Carbon	-	0.74
Silicon	-	0.18
Manganese	-	0.87
Sulphur	-	0.025
Phosphorus	-	0.021
Chromium	-	None detected.

Hardness Test:

The hardness of these springs was found to be 430 V.H.N. (43.5 Rockwell 'C').

Microscopic Examination:

Longitudinal sections of the springs were examined under the microscope. Quite a number of inclusions, both in cluster groups and elongated, were found. Figure 1 shows this condition.

The edge of the spring was also examined and was found to be rough. This condition is shown in Figure 2.

Figure 3, a photomicrograph at X1000 magnification, shows that the structure of the spring is a uniform tempered martensite.

Discussion of Results:

The chemical analysis shows that the type of steel used in the manufacture of these springs is a plain high-carbon steel rather than a silico-manganese or a chromium steel.

The hardness and structure of the steel are normal.

The main source of trouble is believed to be the

(Discussion of Results, cont'd) -

inclusions and surface irregularities. Both may act as stress raisers and considerably lower the fatigue strength, as the notch sensitivity of this hard type of steel is quite high. Indeed, the detrimental inclusions are only those which happen to be at the surface of the steel, but the probability of their occurrence at this location is quite high on account of the number found in the steel.

CONCLUSIONS:

The inclusions and irregularities of the surface are believed to be the cause of failure. Shotblasting of the surface would most certainly improve the spring performance.

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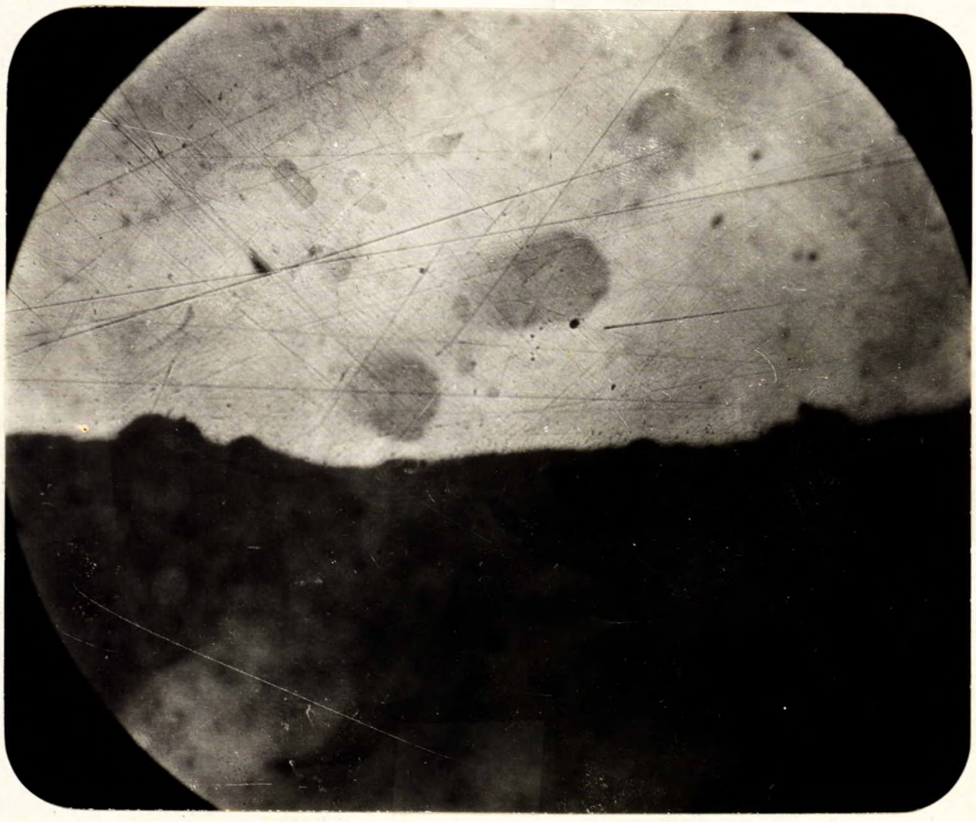
Figure 1.

X100, picral etch.

PHOTOMICROGRAPH SHOWING AN EXAMPLE OF THE TWO TYPES OF INCLUSIONS.

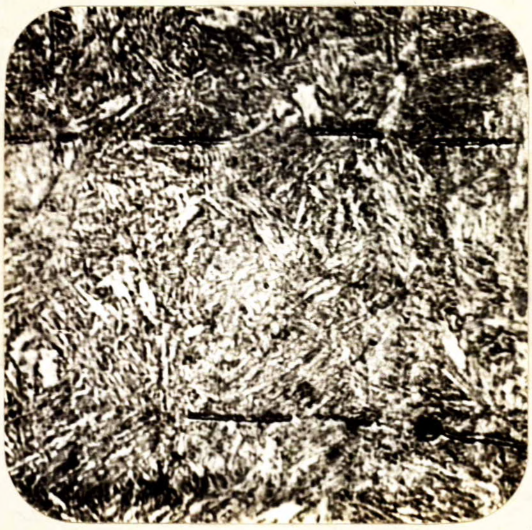
Figure 2.



X75, unetched.

SHOWING SURFACE IRREGULARITIES.

Figure 3.



X1000, picral etch.

PHOTOMICROGRAPH SHOWING THE MICROSTRUCTURE
AND SOME ELONGATED INCLUSIONS.

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