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R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1355.

Examination of a Defective Muzzle Brake.

(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
OTTAWA

February 12th, 1943.

REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1355.

Examination of a Defective Muzzle Brake.

Origin of Sample:

On February 5th, 1943, a double baffle muzzle brake for a 6-pounder gun was received for examination from Colonel H. N. Sowdon, for Military Technical Adviser, Department of Munitions and Supply, Ottawa, Canada. The request letter (File No. 608/D4-6-6H) reported that this brake had been installed on a barrel and subjected to a 200-round firing trial. This casting had noticeable defects, which appeared to be cracks.

Object of Study:

Request was made for an examination of the muzzle brake in order to determine the nature of the defects present.

Chemical Analysis:

The chemical analysis of this part was determined to be as follows:

Carbon	-	0.27
Manganese	--	0.65
Sulphur	-	0.034
Silicon	-	0.040
Phosphorus	-	0.024

Macro-Examination:

The exterior of the brake was "magnafluxed" in an attempt to reveal surface imperfections. The only discovered discontinuity of this surface is shown in Figure 1. This defect is in line with the parting line of the core.

The interior surface of the muzzle brake had, along the parting line of the core, several cracks in the metal (Figure 2). The interior surface, opposite the discontinuity discovered by magnafluxing, was cracked. A cross-section of this crack was removed and polished. This is pictured (with the exterior surface denoted by point A), at about 7 diameters, in Figure 3.

The muzzle brake had a Vickers hardness number of about 162.

Microstructure:

The cross-section of the crack, previously removed, was polished for metallographic examination.

Part of the defect, with the inclusions present (probably oxide), is depicted, at 100 and 1000 diameters respectively, in Figures 4 and 5.

After etching the part in 2 per cent nital, it was found that the area around the defect was decarburized. Figure 6, taken near the crack, and Figure 7, from the parent metal, show that there is a difference in carbon content.

Discussion of Results:

The decarburization and the oxide inclusions in the defective portion of the muzzle brake show that the defects were formed when the muzzle brake was cast and were not incurred in subsequent service. The fact that the interior surface of this brake was not decarburized nearly as much as was the defective area is taken to mean that all of the decarburization present did not occur on heat treatment. These defects, which are of the shrinkage type, were probably caused by one or a combination of the following:

1. Excessive turbulence of the metal at this point, caused by gases emanating from the core or, more probably, the core paste.

2. A core that had too high a hot strength, causing the metal to tear at this point on contraction.

The microstructure indicates that this muzzle brake was given a normalizing heat treatment.

Careful inspection should prevent further parts with defects of this type from entering service. This Division is not familiar with the requirements of muzzle brakes but since this one withstood 200 rounds and was still unbroken, it is quite possible that defects of the type discussed herein are not critical.

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Figure 1.

(Approximately ¼ size).

This shows defect discovered on the exterior surface (outlined with magnaflux powder).

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Figure 2.

(Approximately ½ size).

Partial section of muzzle brake, showing defects along the parting line of the core.

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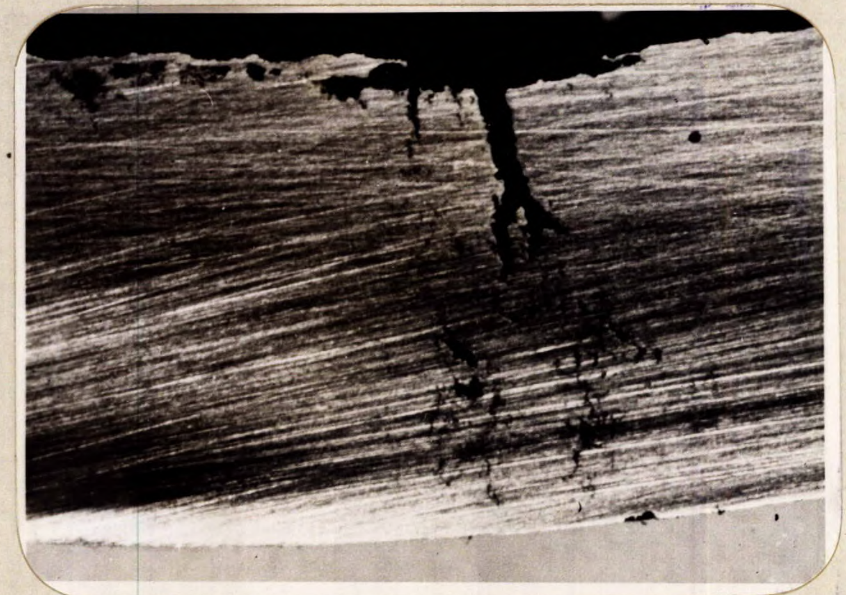
Figure 3.



(Approximately X7).

Cross-section of defect shown in Figure 1.

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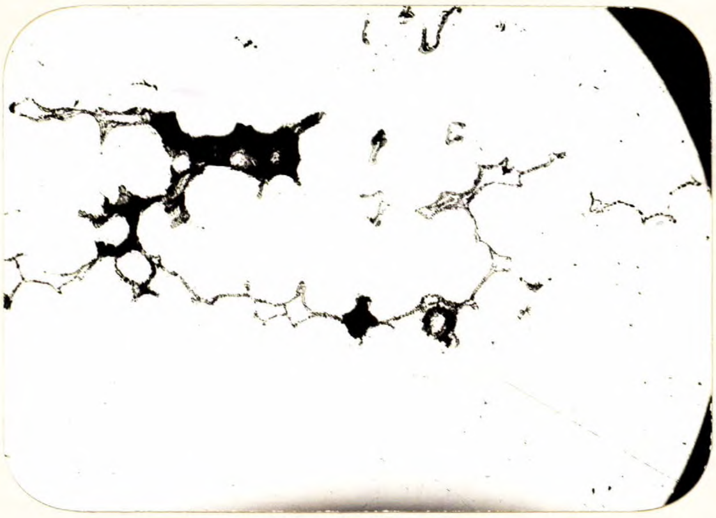
Figure 4.



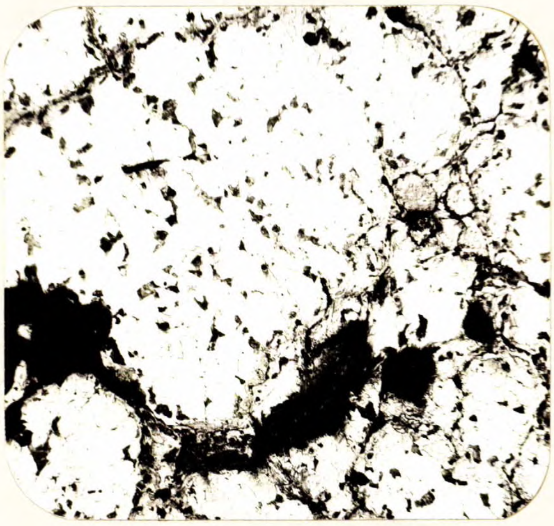
X100, unetched.

Figure 5.

X1000, unetched.

NATURE OF DEFECT.

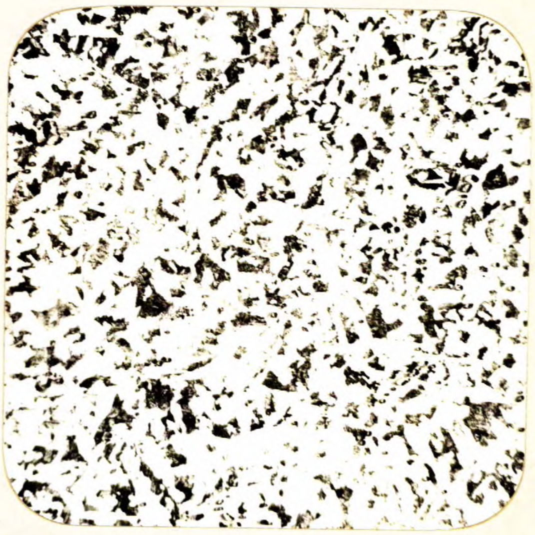
Figure 6.



X100, nital etch.

Photomicrograph showing structure at defective area.
Carbide is small dark constituent in white matrix (ferrite).

Figure 7.



X100, nital etch.

Normalized structure of parent metal.
Carbide is dark constituent.

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