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O T T A W A November 11th, 1944.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1739.

Examination of Three Manganese Steel Castings.

(Copy No. 10.)

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Origin of Material and Object of Investigation:

On November 1st, 1944, a request was received from Mr. J. A. Critchley, works manager of the Sorel Steel Foundries Limited, Sorel, Quebec, for an examination of a sample of manganese steel cut from a bucket. It was suggested that the steel might not have been heated to a sufficiently high temperature in heat treatment.

On November 4th, 1944, Mr. F. Lapointe, of the company's Sales Department, also at Sorel, submitted requests for investigations into the failure of two manganese steel castings. One of these, a dipper tooth point, had failed after only a few hours of service, and the other, a piece of grizzly bar, had broken while being straightened under the press.

As the examination of these three samples showed that the nature of the trouble was the same in each case, the investigation of all three will be covered in this report.

Chemical Analysis:

The following chemical analyses were obtained:

	Bucket	Dipper Tooth	Grizzly Bar
		- Per Cent -	
Carbon -	1.15	1.07	1.20
Manganese -	11.42	11.54	11.42
Silicon -	0.81	0.53	0.47
Sulphur -	0.049	0.049	0.052
Phosphorus -	0.009	0.010	0.009

Microstructure:

The microstructures of the three samples are shown in Figures 1 to 3. Figure 4 is a photomicrograph of the structure obtained on quenching a sample of manganese steel from 1700° F. The four specimens had similar microstructures. They all contain coarse carbides at the grain boundaries, with the usual background of austenite.

Discussion:

The fact that a similar microstructure was obtained by quenching a sample from 1700° F. indicates that the steel had been underheated, as suggested in Mr. Critchley's letter. The as-cast structure has not been removed.

Conclusions:

1. All three samples of manganese steel had a normal chemical composition.

2. The samples had all received similar heat treatment, which was unsatisfactory for this type of steel.

3. In all probability the samples had been underheated.

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AEM:GHB.

Figure 1.

X100, nital etch.

MICROSTRUCTURE OF SAMPLE FROM BUCKET.

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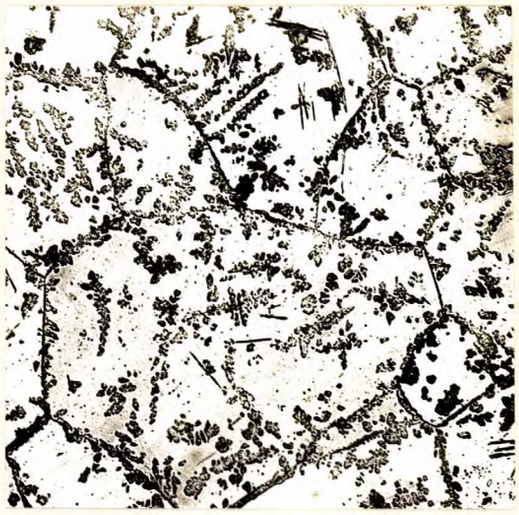
Figure 2.



X100, nital etch.

MICROSTRUCTURE OF SAMPLE FROM DIPPER TOOTH.

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Figure 3.

X100, nital etch.

MICROSTRUCTURE OF SAMPLE FROM GRIZZLY BAR.

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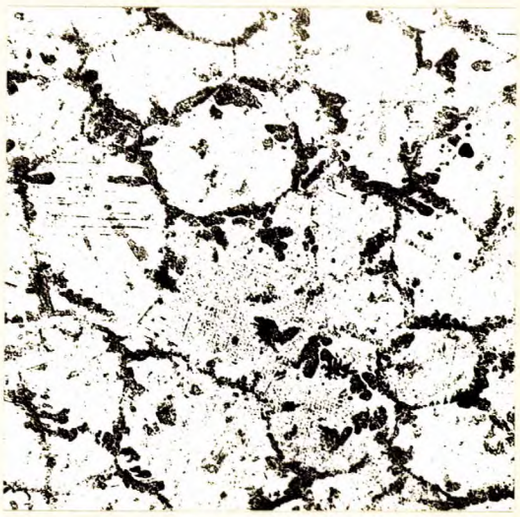
Figure 4.



X100, nital etch.

MICROSTRUCTURE OF SAMPLE QUENCHED FROM 1700° F.

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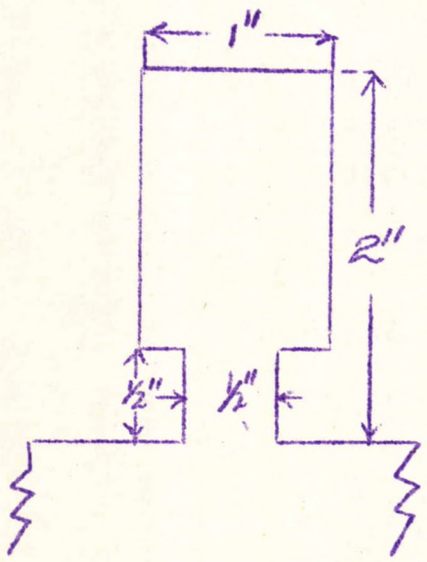
All samples consist of coarse carbides at grain boundaries, in a background of austenite. As-cast structure has not been removed.

AEM:GHB.

APPENDIX TO REPORT OF INVESTIGATION NO. 1739.

The use of a knock-off plug is offered as a suggestion which might insure against the delivery of any poorly heat-treated steel. The plug could be attached to the pattern, and knocked off just before the casting is shipped. If the steel was improperly heat-treated the plug would be brittle.



SUGGESTED KNOCK-OFF PLUG.

Ottawa, Nov. 11, 1944.
A.M.:GHB.