O T T A W A January 21st, 1941.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 950.

Examination of an Austenitic Manganese Steel Casting.

BUREAU OF MINES
DIVISION OF METALLIC MINERALS
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CANADA
DEPARTMENT
OF
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Source of Material and Object of Investigation:

On January 11th, 1941, Mr. T. Spears, Metallurgist, Sorel Steel Foundries Limited, Sorel, Quebec, sent in a section from an austenitic manganese steel casting. It was stated that the casting had broken in service and an examination was requested in order to determine, if possible, the reason for this failure.

Chemical Composition:

Chemical analysis of the steel gave the following results:

Carbon, per cent	Manganese, per cent	Silicon, per cent	Phosphorus, per cent	Sulphur, per cent
1.25	13.37	1.00	0.057	0.007

Macro-Examination:

The casting as received appeared to be of sound metal. There was no evidence of any imperfection where the break occurred.

Micro-Examination:

A sample of the steel was cut from the casting at the fracture and given a metallographic polish. The specimen was examined under the microscope in the unetched condition. The steel was found to be fairly clean. After etching in a solution of 2 per cent nitric acid in alcohol the steel was re-examined. Figure 1 is a photomicrograph at X100 magnification of the etched material and shows the structure to consist of large austenite grains with free carbides along the grain boundaries and slip planes within the grains. Figure 2 is a photomicrograph at X1000 magnification and shows the carbides (the white constituent) along one of the grain boundaries.

Discussion of Results:

The casting had the appearance of being composed of good sound metal, being free from blow-holes and other surface imperfections. The chemical composition is within the limits specified by the A. S. T. M. for austenitic

(Discussion of Results, cont'd) -

manganese steel castings. The soundness of the casting together with its composition would indicate that the steel was properly made and moulded.

The large austenitic grain structure of the metal is the result of pouring the steel from too high a temperature. This coarse-grained structure would lower the physical properties of the casting.

To render the casting strong and tough it is necessary to effect a solution of the cementite and to fix the metal in the austenitic condition. This is effected by heating the steel to 1850° F. to 1925 F., holding at temperature 1 hour per inch of cross-section, and quenching rapidly in cold water.

If after this treatment the steel is again heated up to above 750° F. these carbides will come out of solution.

The nature of the carbides present at the grain boundaries indicates faulty heat treatment rather than a reheating of the metal.

Conclusion:

The failure of the casting can be attributed to the large grain size and the embrittling effect of the free carbides at the grain boundaries.

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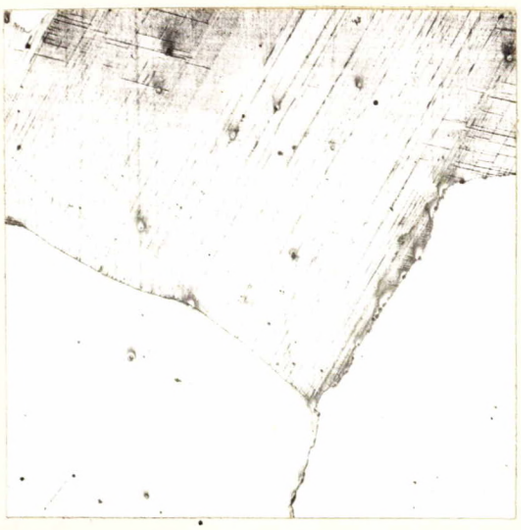
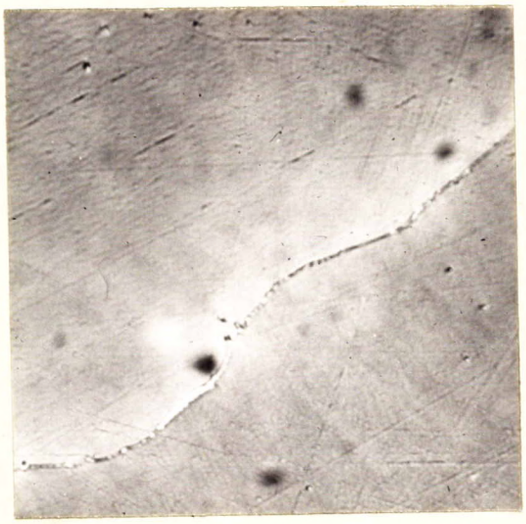
NBB:PES.

Figure 1.



X100.
Etched in 2 per cent Nital.

Figure 2.



X1000.
Etched in 2 per cent Nital.

NBB:PES.