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O T T A W A December 30th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1339.

Examination of Manganese Steel Crusher Jaw Plates from the Sorel Steel Foundries Limited, Sorel, Quebec.

(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

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Origin of Samples:

On December 21st, 1942, Mr. J. R. Blais, of the Sales Department, Sorel Steel Foundries Limited, Sorel, Quebec, submitted two samples, one marked "24 x 15" and the other "20 x 10", cut from manganese steel crusher jaw plates which had failed after five and four days, respectively, in the service of the Canadian Carborundum Company.

Object of Study:

Request was made for chemical analysis of the samples and investigation of the microstructures, in order to determine, if possible, the cause of failure.

Chemical Analysis:

Drillings from the castings were chemically analysed. The results follow:

		"24 x 15"	"20 x 10"
		- Per cent -	
Carbon	-	1.09	1.12
Manganese	-	12.38	12.40
Silicon	-	1.20	0.63
Phosphorus	-	0.049	0.062
Sulphur	-	0.013	0.007

Macro-Examination:

The plates broke with a brittle, crystalline fracture. Pores up to about 1/8-inch diameter, most noticeable in the "20 x 10" crusher plate, extended back from the surface into the interior of the castings.

Microstructure:

A specimen from each of the plates was polished and then etched in 2 per cent nitric acid. Both specimens contained large amounts of free carbide present as patches of globules and as a network around the grain boundaries. This is illustrated in Figures 1 and 2.

Many globular inclusions, thought to be oxide, were discovered in both samples. The largest, found in the "20 x 10" plate, was approximately 0.018 inch in diameter. A shrinkage cavity discovered in the "20 x 10" plate is shown, at 100 diameters, in Figure 3.

Discussion of Results:

The porosity in the plates was caused by faulty casting technique. These pores would weaken the parts and for this reason may have contributed to their failure. The globular inclusions and the small shrink present in the

castings are defects of minor importance.

In the "24 x 15" plate the silicon is rather high, but since the sample has not an excessive amount of silicate inclusions this is thought to be practically harmless.

The greatest single cause of failure is certainly the large amount of free carbide present, because manganese steel develops its well-known toughness only when all the carbon is in solution.

The free carbides present were caused by one or more of the following:

1. A quench from too low a temperature.
2. Insufficient soaking time at the correct temperature.
3. A quench that was not drastic enough, or one in which some delay occurred.

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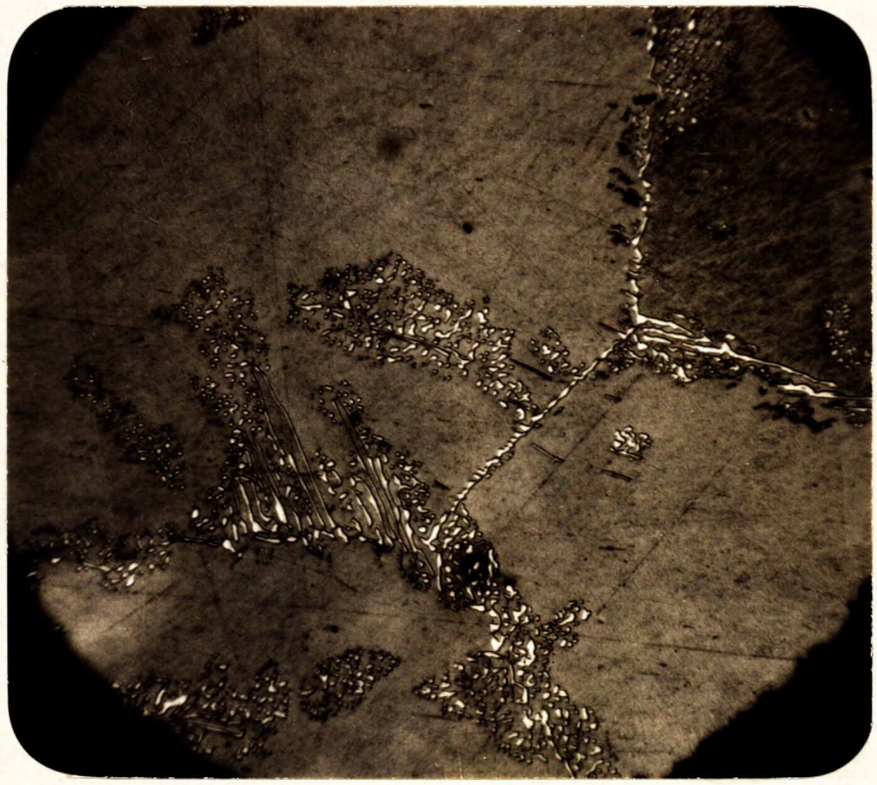
Figure 1.

X1000, nital etch.

"24 x 15" CRUSHER JAW PLATE.

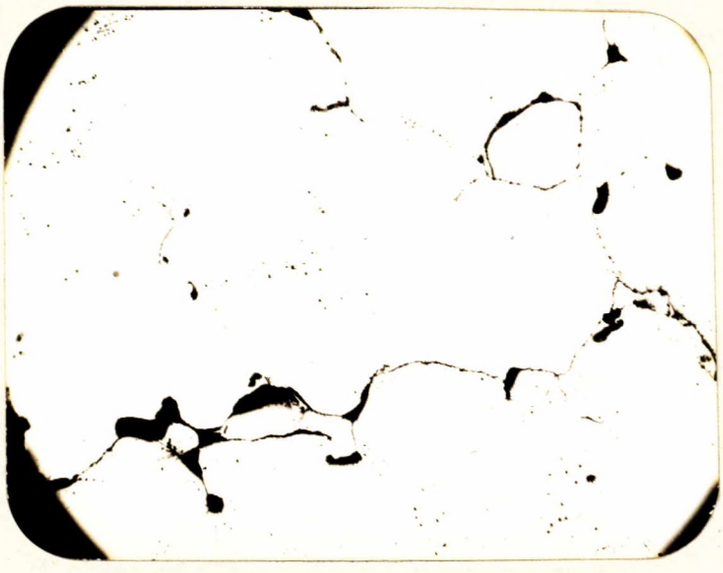
Figure 2.



X1000, nital etch.

"20 x 10" CRUSHER JAW PLATE.

Figure 3.



X100, unetched.

SHRINK IN "20 x 10" PLATE.

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