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# R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1730.

## Examination of a Defective Manganese Steel Jaw Plate.

(Copy No. 10.)

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Origin of Request and Object of Investigation:

On October 16th, 1944, a request was received from the Joliette Steel Limited, Joliette, Quebec, for an investigation into the failure of a manganese steel jaw plate. The casting had been used by the International Nickel Co. of Canada Ltd., and had failed shortly after installation. A sample of the plate was received on October 19th.

Chemical Analysis:

The sample was found to have the following chemical analysis:

| | As Found - Per Cent - | Specified Range - Per Cent - |
|---|---|---|
| Carbon | 1.51 | 1.00-1.40 |
| Manganese | 15.96 | 10.00 min. |
| Silicon | 1.01 | 0.3-1.0 |
| Phosphorus | 0.095 | 0.10 max. |
| Sulphur | 0.037 | 0.05 max. |
| Chromium | 0.15 | |

Microstructure:

Figure 1 is a photomicrograph of the structure as received.

Figure 2 is a photomicrograph of the structure after a quenching from 1900° F.

Discussion:

The high manganese content of the steel is probably not detrimental, but it is certainly uneconomical. Most producers try to keep the manganese between 11 per cent and 14 per cent.

The high carbon content of the steel is the real source of the trouble. With such a high carbon content the steel still contains free carbides at the ordinary soaking temperatures even though the carbon-manganese ratio is correct. This is confirmed in the photomicrograph of the specimen quenched from 1900° F. (Figure 2), which shows that the steel still contains carbides at the grain boundaries and throughout the grains. The steel has too high a carbon content to be satisfactory after the normal heat treatment for manganese steel.

The free carbides at the grain boundaries of the

(Discussion, cont'd) -

casting as received (see Figure 1) are undoubtedly the cause of the failure, and are the result of the high carbon content.

The steel also contained an excessive number of shrinkage cracks, and these probably contributed to the failure.

Conclusions:

1. The casting failed because of free carbides at the grain boundaries.

2. The carbon content of the steel was above specification for manganese steel. This off-standard analysis was the cause of the free carbides observed.

3. The steel was probably correctly heat-treated.

4. Excessive shrinkage cracks probably contributed to the failure.

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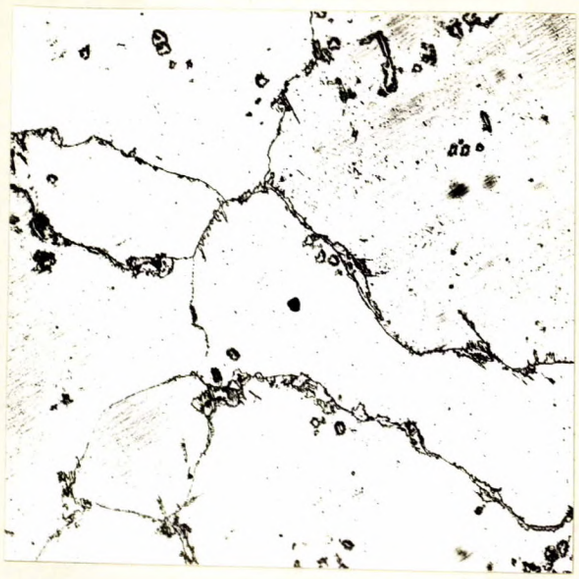
AEM:GHB.

Figure 1.



X100, nital etch.

MICROSTRUCTURE AS RECEIVED.

Free carbides at grain boundaries and throughout the grains.

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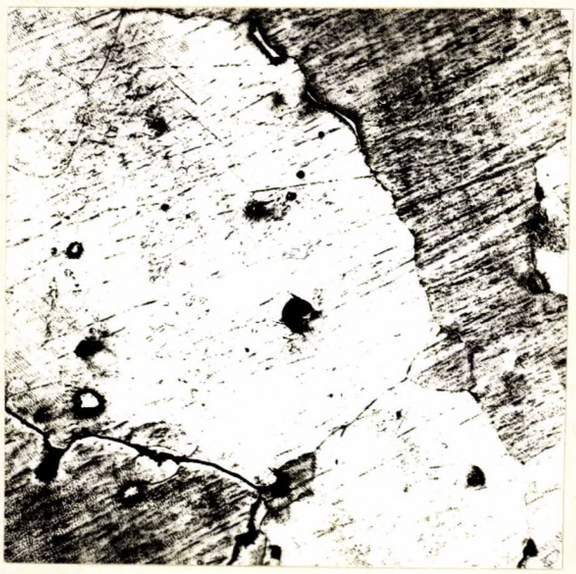
Figure 2.



X100, nital etch.

MICROSTRUCTURE AFTER QUENCHING FROM 1900° F.

Free carbides at grain boundaries and throughout the grains. Excessive shrinkage cracks.

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AEM:CHB.