CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION IR 58-101

METALLURGICAL EXAMINATION OF A SECTION FROM A CRACKED MANGANESE STEEL MANTLE

by

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PHYSICAL METALLURGY DIVISION

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JULY 3, 1958

Mines Branch Investigation Report IR 58-101

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SUMMARY OF RESULTS

The surface from which the crack originated was found to contain a large amount of grain boundary carbides as well as massive carbides within the grains. The presence of this carbide was probably due to too short a time at the heat treating temperature.

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(1 table, 2 illus.)

INTRODUCTION

A section cut from a cracked manganese steel mantle was received at the Physical Metallurgy Division, Ottawa, on April 30, 1958, from Mr. J. Hebert, Plant Metallurgist, Joliette Steel Division, Joliette, Quebec. The covering letter stated that the casting, which weighed 14,000 pounds, was cast in 1957 and started to crack before it went into service. A similar casting, made in 1956, has stood up well in service, and had an analysis very similar to the cracked one. It was requested that the cause of the cracking be determined.

RADIOGRAPHIC EXAMINATION

The section was examined by radiographic techniques. This showed one main crack and an area of sponginess (shrinkage).

SECTIONING

A sectional sample, which included the lower portion of the crack, was torch cut from the as-received section. Care was taken that the smaller section never exceeded 700°F in the cutting operation. The smaller sample was again sectioned, using an abrasive cut-off wheel, in order to obtain a more manageable piece of the casting with which to work. Drillings for chemical analyses, and pieces for microscopic examination, were removed from this smallest sample.

CHEMICAL COMPOSITION

The results of chemical analyses of drillings obtained from the small piece, as well as the results supplied by Joliette Steel Division for this casting and the good one produced in 1956, are given below in Table I.

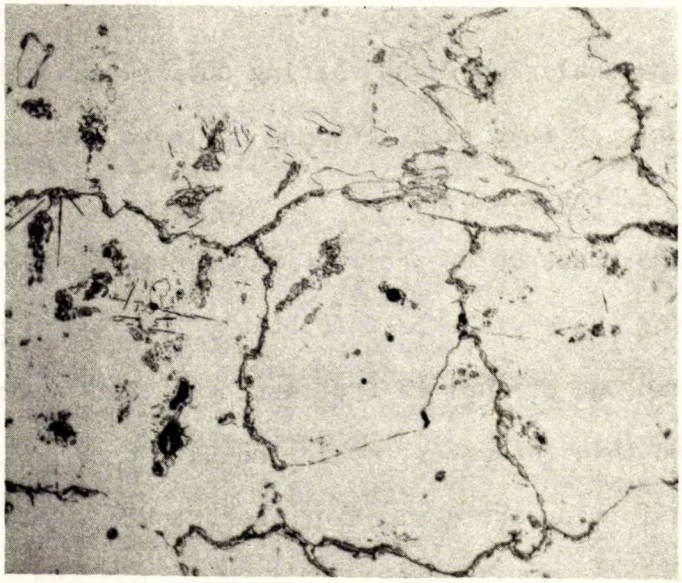
Table I

Analyses of Cracked Mantle and Good Mantle

Element	Cracked Mantle		Good Mantle
	Mines Branch (%)	Joliette (%)	Joliette (%)
C	1.12	1.15	1.08
Mn	12.94	12.51	12.82
Si	0.87	0.84	0.79
S	0.013	-	-
P	0.055	0.046	0.044
Cr	2.08	1.93	2.01

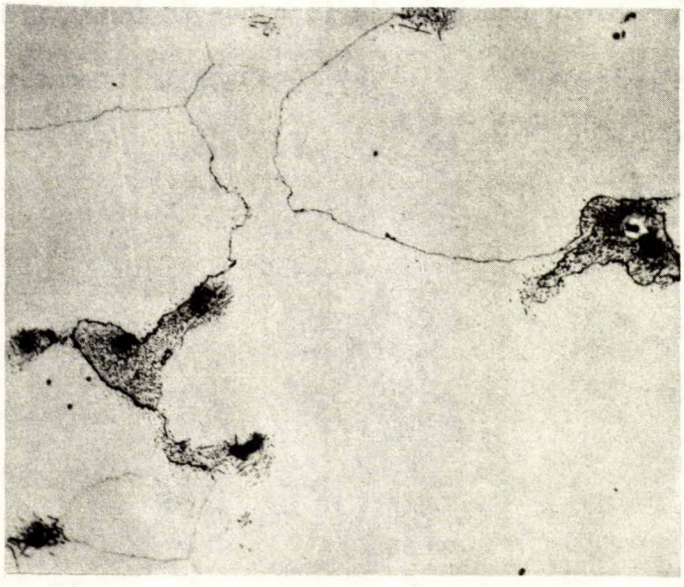
METALLOGRAPHIC EXAMINATION

Samples taken from the smallest piece were suitably prepared and then examined by means of a microscope. This showed the presence of a continuous network of carbides at the grain boundaries and massive carbides within the grains at one surface of the casting (see Figure 1). At the other surface, a smaller amount of grain boundary carbide and massive carbide is present (see Figure 2). The photomicrographs also show a larger than normal grain size, indicating a pouring temperature too high for the section size of the casting.



(x100, etched in 6% nital)

Fig. 1. - Field near surface from which cracks originated; showing large amount of carbide present. Note, also, the large grain size.



(x100, etched in 6% nital)

Fig. 2. - Field near opposite surface to that of Figure 1, showing smaller amount of carbide present in this location. Note the large grain size.

DISCUSSION

The analysis of the casting obtained at the Mines Branch is in agreement with that supplied, and fails to indicate any troublesome abnormality in the composition.

The presence of the continuous network of grain boundary carbide along one surface is undoubtably the reason for the cracks. The fact that one surface of the casting is closer to being properly heat treated than the other, would indicate that insufficient time at temperature is a probable cause of the trouble.

CONCLUSIONS

1. Large amounts of both grain boundary carbides and massive carbides were found near the surface from which the cracks originated, and are the reason for the cracks.

2. Since one surface is close to being properly heat treated, insufficient time at temperature is probably the cause of the trouble.

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