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OTTAWA December 15, 1945.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1979.

Metallurgical Examination of a Broken Grey Iron Casting.

(Copy No. 6.)

Bureau of Mines
Division of Metallic
Minerals

Physical Metallurgy
Research Laboratories

CANADA

DEPARTMENT
OF
MINES AND RESOURCES

Mines and Geology Branch

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Source of Material and Object of Investigation:

On November 20, 1945, Mr. E. Swartzman, of the Division of Fuels, Bureau of Mines, Ottawa, Ontario, submitted for examination a broken cast iron paddle from a Kemarek-Greaves[*] feeder.

It was stated that this casting had failed prematurely in service, and a full metallurgical examination was requested in order to determine, if possible, the cause of failure.

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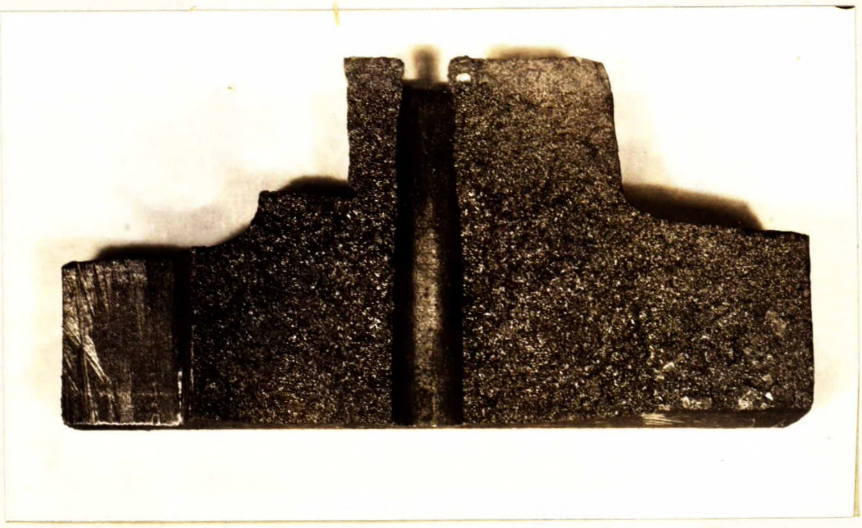
[*] Kemarek-Greaves & Co., 2939-2945 North Mozart St., Chicago, Ill.

Macro Examination:

Figure 1 is a photograph showing the fracture of the paddle. The casting appeared to be free from surface defects. However, the metal at the fracture appeared fairly coarse-grained.

Figure 1.



SHOWING FRACTURE.

(Approximately to size).

Chemical Analysis:

Drillings taken from the casting had the following chemical composition:

		Per Cent
Total carbon	-	3.17
Graphitic carbon	-	2.57
Manganese	-	0.60
Silicon	-	2.10
Phosphorus	-	0.143
Sulphur	-	0.082
Nickel	-	1.40
Chromium	-	0.30

MECHANICAL TESTS:

Hardness Tests -

The hardness of the iron was determined by the Brinell method, and the following values were obtained:

Location		Brinell Hardness
Surface	-	187
Centre	-	156

(Mechanical Tests, cont'd) -

Tensile Tests -

A tensile specimen taken from the casting had an ultimate strength of 20,000 pounds per square inch.

Microscopic Examination:

A specimen of the casting adjacent to the fracture was mounted in bakelite, polished, and examined in the unetched condition under the microscope. Figure 2 is a photomicrograph, at X100 magnification, showing the coarse structure of the graphite flakes in the iron. Some microporosity can also be observed (at "A") in this photomicrograph.

Figure 2.

X100

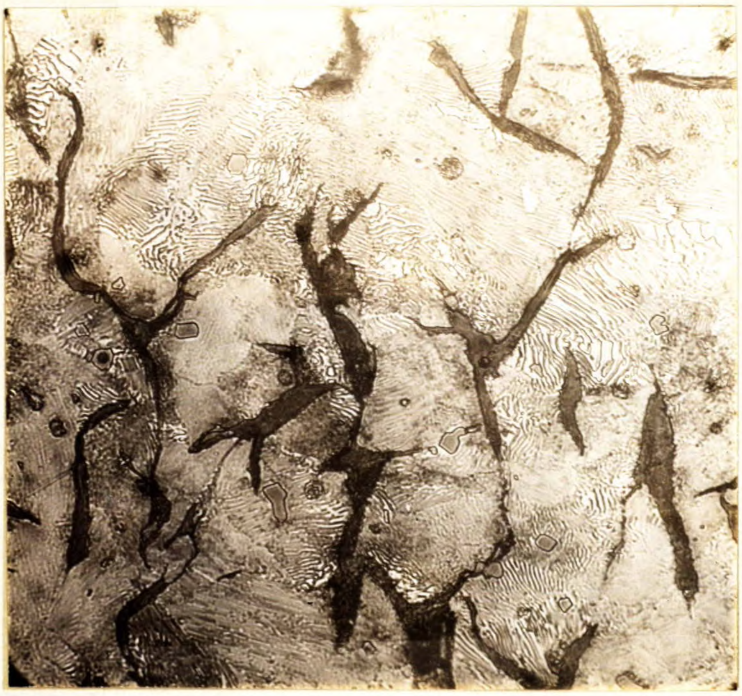
SHOWING GRAPHITE FLAKES
IN UNETCHED SPECIMEN.

Figure 3 shows the nital-etched structure of the iron at X500 magnification. The matrix consists of pearlite.

(Continued in next page)

(Microscopic Examination, cont'd) -

Figure 3.



X500.

SHOWING THE NITAL-ETCHED STRUCTURE.

Discussion of Results:

The casting was found to be an alloy cast iron containing nickel and a small addition of chromium. The amounts of silicon and nickel in this iron are considered to be too great. Both elements are graphitizing agents and therefore tend to produce large graphite flakes in the iron. This condition can be controlled by lowering the addition of either element. The coarseness of the fracture observed in this casting is generally associated with large graphite flakes and low tensile strength. This was confirmed by a microscopic examination of the iron and a determination of its tensile properties.

From the results of this examination it is concluded that failure was due to the low tensile properties of the iron.

It is recommended that these castings be made from an iron with a properly balanced nickel-silicon content, which would produce a metal with superior mechanical properties.

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