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METALLURGICAL EXAMINATION OF A SECTION OF A CAST IRON GEAR HOUSING

by

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PHYSICAL METALLURGY DIVISION

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Physical Metallurgy Division

SUMMARY OF RESULTS

The defects detected in the surface of the casting consisted of voids and entrapped slag. A microscopic examination revealed undesirable microconstituents and a chemical analysis revealed that the desired composition had not been obtained.

Corrective measures suggested to aid in offsetting these defects included (a) changes in the composition to improve the carbon equivalent, and (b) alterations in moulding, pouring and slagging practices to prevent voids and slag entrapment.

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Origin of Material and Object of Investigation:

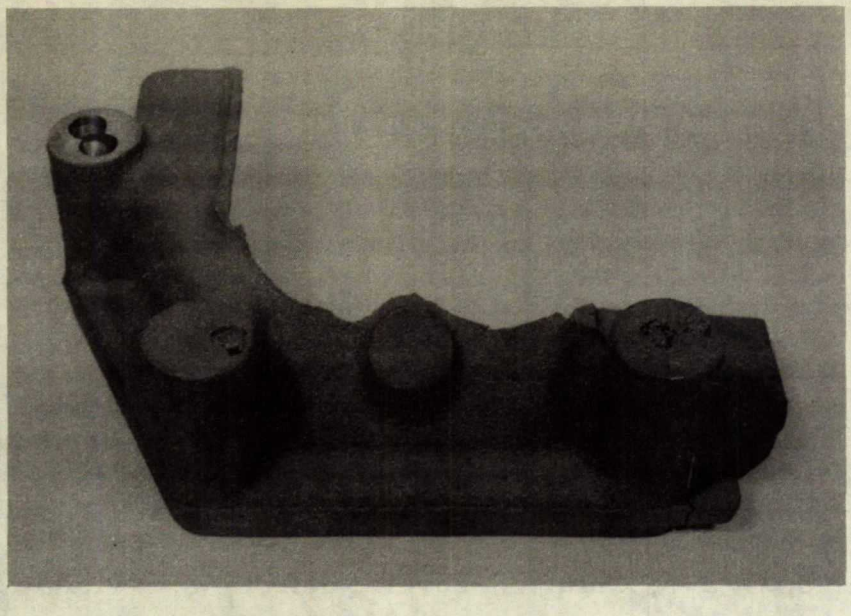
A section from one end of a casting for a gear housing was submitted on December 6, 1957, by the Beach Foundry Limited, Ottawa, Ontario. Several defects were visible in the end of the casting. These defects consisted mainly of voids, although there was also some evidence, on the surface, that slag had been carried into the casting.

An examination of the section of the casting was requested, to determine the nature and extent of the defects observed on the surface.

Visual Examination:

Figure 1 shows a photograph of a section from one end of the casting. Some evidence of voids can be seen in the photograph.

Fig. 1.



(Approximately 1/3 actual size)

THE SECTION FROM ONE END OF A CASTING FOR A GEAR HOUSING, SHOWING SOME OF THE VISIBLE VOIDS.

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Radiography:

Examination by radiographic techniques confirmed evidence of considerable shrinkage and gas cavities in the sections submitted from one end of the casting.

Chemical Analyses:

The chemical composition was determined by analyses of samples obtained in one of the bosses (i.e. heavy section). The results are shown in Table 1, below, together with the target analysis:

Table 1. - Chemical Composition.

Element	Gear Housing %	Target Analysis %
Carbon (total) -	3.49 (drillings) 3.53 (pencil)	3.15-3.25
Carbon (combined) -	0.70	
Silicon -	2.33	1.75-1.80
Manganese -	0.69	0.5 -0.6
Sulphur -	0.10	0.10
Phosphorus -	0.32	0.30
Chromium -	*0.20	

*0.30 to 0.40 points of chromium were added in the ladle besides the ferrosilicon inoculant.

The actual composition shows a considerable difference from the target composition with regard to carbon and silicon. This would give a carbon equivalent of 4.3.

A medium strength (35,000-45,000 psi) grey iron was desired which would be expected to have a carbon equivalent of approximately 3.7.

Hardness:

Hardness values of 207 Brinell were obtained on an intermediate section, of approximately 3/4 inch thickness, using a 3000-kg load.

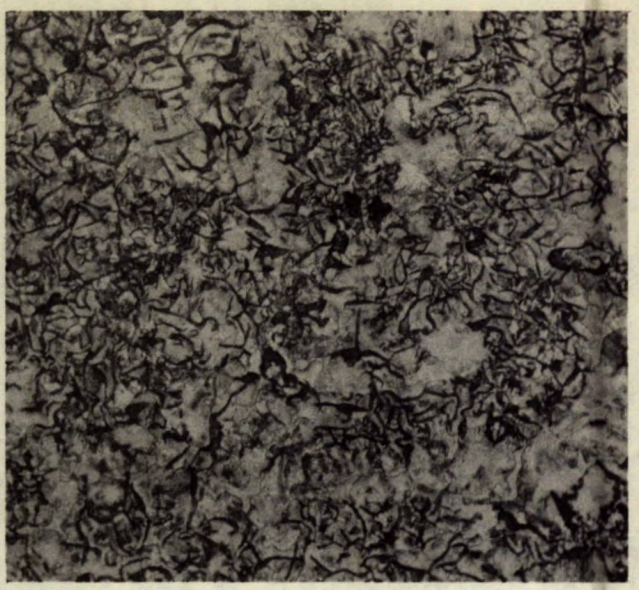
Microscopic Examination:

Specimens from the very thin and from the thick sections were examined microscopically. Figures 2 and 3, respectively, show typical fields from these sections.

Fig. 2.

Etched in 2% nital. X100
Thin Section

Fig. 3.



Etched in 2% nital. X100
Thick Section

TYPICAL FIELD FROM VERY THIN AND VERY THICK SECTIONS.

The microstructure consists of a pearlitic matrix and the rosette type of graphite associated with ferrite. Also, small areas of phosphide eutectic are evident.

Conclusions:

1. The target analysis was not obtained.

2. The silicon in the target analysis is considered to be slightly low for the strength of iron desired. This is particularly true if small quantities of chromium are added.

3. The high carbon content obtained is generally associated with a low strength Class 20 iron.

4. A carbon content of 3.15 to 3.25 percent and a silicon

content of 2.00 to 2.20 percent would give a carbon equivalent of 3.8. This is a more desirable equivalent for irons of intermediate strength than the value 4.3.

5. The silicon content suggested in conclusion 4 is slightly higher than that shown for the target analysis. This should help offset the undercooling in the thin section and thereby give an improved graphitic structure.

6. The gas and shrinkage difficulties near the gate should be remediable by improvements in the moulding technique (e.g., "whistlers" on the bosses in the region of the gates), and by maintaining good fluidity during pouring. Better skimming of the ladle during pouring may also be necessary.

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