O T T A W A June 9th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1240.

Examination of Steering Knuckle Flange Casting.

(Copy No. 6.)

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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Source of Material and Object of Investigation:

A broken steering knuckle flange casting was received on May 26th, 1942, from the Inspection Board of the United Kingdom and Canada, 58 Lyon Street, Ottawa, Ontario, with a request (O.T. 3004) for an examination of its chemical composition and heat treatment. Specifications of the part were given in a blueprint supplied with the casting.

Chemical Analysis:

	Specified	Found
	- Per cent -	
Carbon -	1.35 - 1.55	0.86
Manganese -	0.70 - 0.90	0.46
Silicon -	0.85 - 1.10	1.46
Phosphorus -	0.05 max.	0.062
Sulphur -	0.08 max.	0.020
Copper -	-	0.050

Hardness Test:

Brinell hardness number - 197.

Heat Treatment:

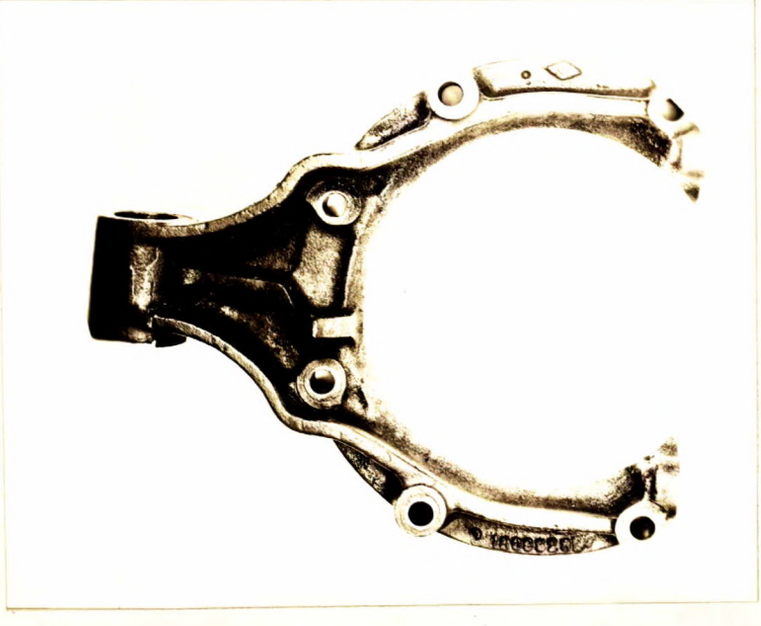
It was specified in the drawing that this steel (a No. 7 copper-silicon cast steel alloy) be heat treated as follows:

0° F.	to 1560° F. -	140 mins.
1560° F.	to 1620° F. -	50 "
1620° F.	to 1650° F. -	73 "
1650° F.	to 1350° F. -	70 "
1350° F.	to 1250° F. -	195 "

Allowed to cool on continuation of furnace rails to handling temperature.

Macro-Examination:

Figure 1.



Approximately 1/3 size.

(Macro-Examination, cont'd) -

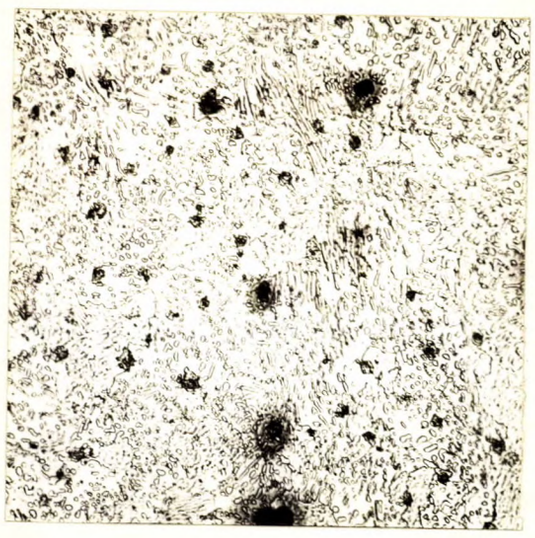
No defects could be observed by visual examination except the fracture shown at "A".

Microscopic Examination:

A polished specimen taken at the fracture was examined under the microscope. No cavities or porosity could be observed.

The structure of the metal as revealed after an etch in 2 per cent nital is shown in Figure 2 (X500 magnification). It may be seen that the cementite is spheroidized and that the steel also contains dark spots which are probably graphite. Spheroidization has only just been effected, as there are some areas of lamellar pearlite also visible.

Figure 2.



X500.
Etched 2 per cent nital.

Discussion of Results:

The composition of the metal does not comply with the specification for Ford Metal Alloy No. 7. From the results obtained it would appear that another Ford alloy steel was substituted. The carbon content determined for this material

(Discussion of Results, cont'd) -

is probably low, as it is not possible to get a fair sample from a steel that contains free graphite. However, even leaving the carbon percentage out of consideration, the metal has not the specified composition as it contains less manganese and higher silicon than specified. Manganese stabilizes carbide while silicon promotes graphitization. The low manganese high silicon metal received, then, would be expected to contain more graphite than a metal having the specified composition. If, however, the specimen carbon content were lower than specified the tendency to graphitization would be counteracted as the lower carbon material is more stable. It is probable that the carbon content of the specimen examined is below the specified value, but this cannot be determined with certainty as graphite is lost mechanically in the sampling process.

The spheroidized structure of the steel indicates that it has received the proper heat treatment. This heat treatment puts the steel of this analysis in its toughest form. Even in this form there is danger of impact failure in such a high carbon material.

Conclusions:

1. The steel has not the specified composition.

2. The steel had a spheroidizing heat treatment similar to that specified.

3. The failure of this part may be attributed to its composition but it is thought it more probably indicates that the steel specified has not high enough physical properties for the service. In order to obtain a tougher material it would seem that a lower carbon steel would be in order.

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