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O T T A W A October 14th, 1944.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1721.

Further Investigation of Generator Base Castings.

(Subsequent to Report of Investigation No. 1699, dated August 10th, 1944.)

(Copy No. 10.)

Bureau of Mines
Division of Metallic
Minerals

Physical Metallurgy
Research Laboratories

CANADA

DEPARTMENT
of
MINES AND RESOURCES

Mines and Geology Branch

O T T A W A   October 14th, 1944.

REPORT

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(Subsequent to Report of)
(Investigation No. 1699,)
(dated August 10th, 1944.)

Introduction:

On July 22nd, 1944, a request was received from the Directorate of Electrical and Communications Design, Master General of Ordnance Branch, Department of National Defence (Army), Ottawa, Ontario, for an investigation into the failure of grey iron generator base castings. In the report covering that investigation (Report of Investigation No. 1699, August 10th, 1944), it was concluded that the service conditions were too severe for the grade of metal being used. The report recommended that either the casting be redesigned to lower the stress on the metal, or the use of a higher grade of iron be specified. Class 30 iron or malleable iron were suggested as satisfactory.

On October 2nd, Major J. A. Loutit, of the Canadian Signals Research and Development Establishment of the Directorate of Electrical and Communications Design, submitted another generator base for examination. This casting had been designed

(Introduction, cont'd) -

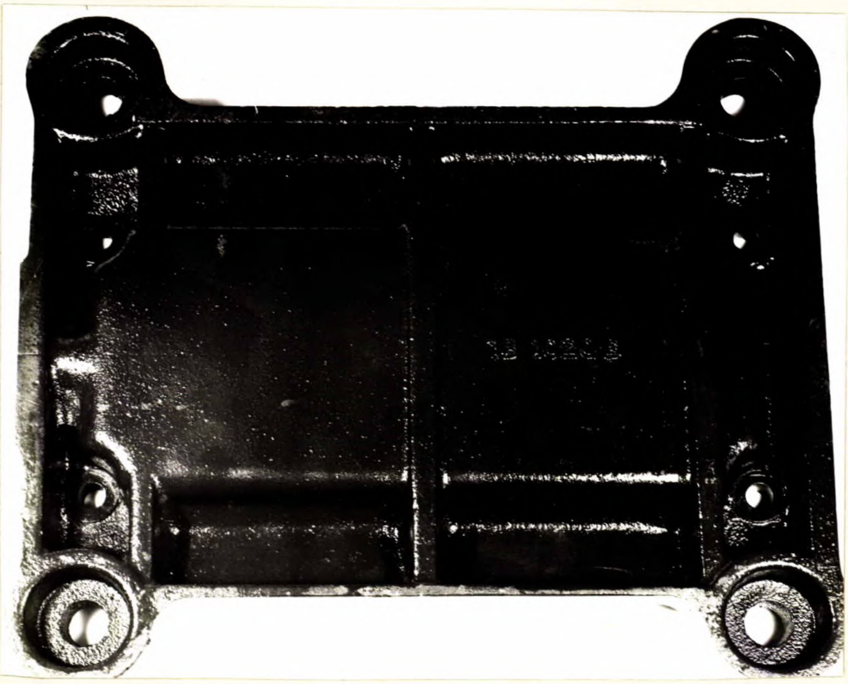
with thicker sections than the first one examined, and had an extra reinforcing rib. The hold-down bolt holes had been enlarged to allow for the use of larger rubber shock absorbers. Class 40 grey iron had been specified. An investigation was requested to determine whether the casting as redesigned could be expected to give satisfactory service.

In the present report the casting first submitted (covered in Investigation No. 1699) will be referred to as Casting No. 1, and the redesigned model as Casting No. 2.

Macro-Examination:

The surface of Casting No. 2 was clean and sound. Figure 1 is a photograph of the casting as received. Figures 2 and 3 are photographs showing comparisons of Castings Nos. 1 and 2. The No. 1 casting is about 0.25 inch and No. 2 is 0.375 to 0.440 inch in thickness.

Figure 1.



IMPROVED CASTING (CASTING NO. 2).

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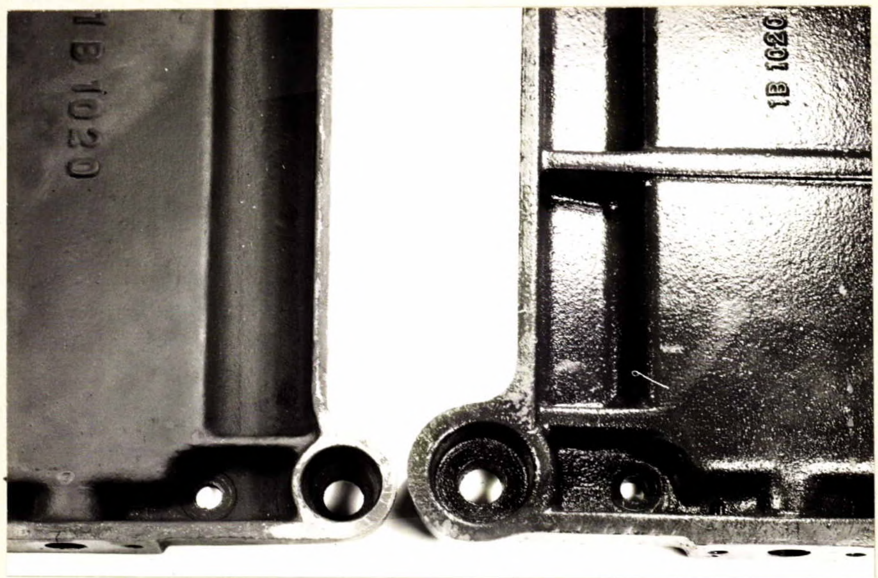
(Continued on next page)

(Macro-Examination, cont'd) -

Figure 2.



COMPARISON OF INITIAL AND IMPROVED CASTINGS.

Improved casting on right.

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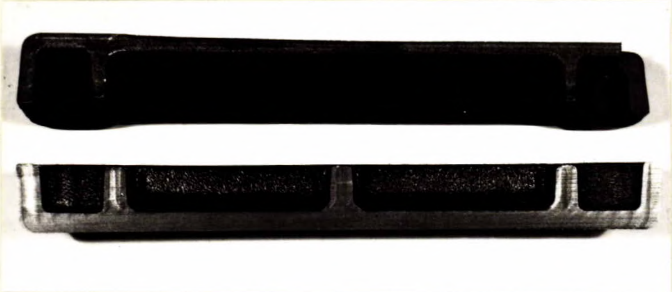
Figure 3.



COMPARISON OF INITIAL AND IMPROVED CASTINGS.

Improved casting at bottom.

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Chemical Analysis:

The chemical analys s of the two castings were as follows:

		Casting No. 1	Casting No. 2
		- Per Cent -	
Total carbon	-	3.39	3.08
Graphitic carbon	-	2.99	2.52
Combined carbon	-	0.40	0.56
Silicon	-	2.38	1.78
Manganese	-	0.70	0.57
Phosphorus	-	0.106	0.107
Sulphur	-	0.068	0.130
Nickel	-	Trace.	Nil.
Chromium	-	Nil.	Nil.

Mechanical Tests:

		Casting No. 1	Casting No. 2
Brinell hardness	-	135	183
Tensile strength (taken from specimen cut from casting)	-	18,000 p.s.i.	33,000 p.s.i.

Microstructure:

Figures 4 and 5 are photomicrographs of the unetched structures of Castings Nos. 1 and 2 respectively.

Figures 6 and 7 are photomicrographs of the etched structures.

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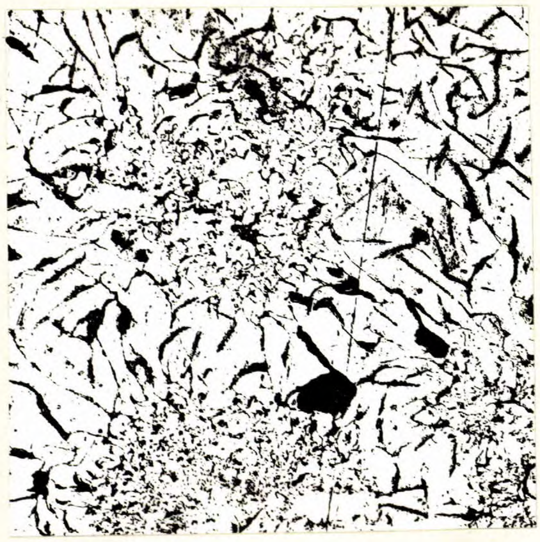
(Microstructure, cont'd) -

Figure 4.



X100, unetched.

GRAPHITE FLAKES
IN NO. 1 CASTING.

"Rosettes" are associated with low-strength iron.

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Figure 5.

X100, unetched.

GRAPHITE FLAKES
IN NO. 2 CASTING.

No "rosettes" in this metal.

-

Figure 6.

X500, nital etch.

MICROSTRUCTURE OF
NO. 1 CASTING.

Large areas of ferrite (white) associated with low strength.

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Figure 7.

X500, nital etch.

MICROSTRUCTURE OF
NO. 2 CASTING.

Almost no free ferrite.

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Discussion:

The increased thickness and the extra rib of the redesigned casting considerably strengthen it. The use of the larger rubber shock absorbers is also an excellent feature, as it strengthens the assembly in fatigue and impact. Even without the use of the better grade of metal these changes would probably result in a satisfactory casting.

The superior quality of the metal in Casting No. 2 is indicated by the hardness and tensile tests, the higher combined carbon and lower graphitic carbon, and the microstructure.

The fact that a specimen cut from the casting had a tensile strength of 33,000 p.s.i. should not be interpreted to mean that this is lower than a Class 35 grey iron. Tensile specimens cut from a casting consistently show lower results than those cast from the same heat of metal into test bars. A.S.T.M. Specification A190-40 for thin-section grey iron castings calls for the use of 0.875-inch cast test bars, rather than sections cut from the casting. This metal is probably better than Class 35 grey iron, and should prove satisfactory in this application.

Conclusions:

1. The improved casting submitted should give considerably better results in service.

2. Both castings were free from cracks, gas holes, flaws, and excessive shrinkage.

3. The metal of the improved casting is approximately Class 35, or better, cast iron. This is of a high enough grade for this application.

4. Tests on 0.875-inch cast tensile bars should be used if a closer check on the quality of the metal is desired.

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