OTTAWA July 27th, 1941.

REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1056.

An Examination of a Stainless Steel Sample.

BUREAU OF MINES
DIVISION OF METALLIC MINERALS
ORE DRESSING AND
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CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

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Origin of Material and Object of Investigation:

On July 10th, 1941, Mr. H. M. Kemp, for the Inspector-in-Charge, British Air Commission, 1785 Massachusetts Avenue, Washington, D. C., U. S. A., sent in a small sample of steel. It was reported that this steel had been made by a U. S. firm for shipment to Great Britain and that trouble had been experienced with steels shipped previously by this manufacturer. An examination of the sample submitted was requested in order to determine, if possible, the reason for this trouble.

Chemical Examination:

Drillings taken from the steel were found to have the following composition:

Carbon, p.c.	Manganese, p.c.	Silicon, p.c.	Phosphorus, p.c.	Sul-phur, p.c.	Nickel, p.c.	Chrom-ium, p.c.
0.14	0.59	0.38	0.017	0.020	1.74	16.36

Hardness Tests:

The steel was found to have a hardness of 305 as determined by the Vickers method, using a 30-kilogram load.

Microstructure:

The steel was quite clean and contained few inclusions. Figures 1 to 4 show the structure of the steel as determined on transverse and longitudinal samples after an etch in a solution containing 10 gms. of ammonium persulphate, 10 c.c. of hydrochloric acid and 100 c.c. of water.

Figure 1.

X200, etched.
Transverse section.

Figure 2.

X200, etched.
Longitudinal section.

(Continued on next page)

(Microstructure, cont'd) -

Figure 3.

X1000, (Etched).

Transverse section.

Figure 4.

X1000, (Etched).

Longitudinal section.

Discussion of Results:

The composition of the steel meets the requirements of B. E. S. A. Specification S-80. The hardness also meets the requirements of this specification, which states that the Brinell number (equivalent to Vickers number in this range) shall not be less than 241. Figures 1 to 4 show that the steel is clean and composed of alpha iron (the white constituent) and greyish areas that are the product of the breakdown of the gamma iron constituent. The nature of the microstructure and the hardness of the steel indicate that it was most probably quenched and drawn at about 1100° F. Previous rolling or forging is responsible for the elongated arrangement of the phases shown in Figures 2 and 4.

The examination of the small sample submitted revealed nothing that would account for the alleged poor

(Discussion of Results, cont'd) -

performance of this steel, for it appeared to be of the correct composition and to have been properly heat-treated. An examination of such a small specimen, however, does not necessarily prove anything, and cracks may occur in the forming of the steel that would be missed in the selection of a small specimen.

In forging this steel it is important that a billet made from a properly chipped ingot be preheated slowly to 1400-1500° F., held at this temperature about twice as long as ordinary steel, and then be given a short soaking time at 1900-2100° F., after which it is forged. No forging should be done below 1600° F. and it is better if the steel be slowly cooled from the forging operation. In heat treatment, the steel is heated slowly to 1750-1850° F., is soaked thoroughly and then quenched, after which it is drawn to the required hardness.

If the steel under examination has given poor service it is probably because the above heat treatment schedule was not followed carefully. A slight overheating of the steel, for instance, may cause splitting or rupture in forging, while cold shots and checks will be found if the material is forged from too low a temperature. Cooling too fast also may cause cracking.

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