O T T A W A September 5th, 1941.

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of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1087.

An Examination of Tungsten-Nickel Plate.

BUREAU OF MINES
DIVISION OF METALLIC MINERALS
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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 August 25th, 1941, two small samples were received from Mr. H. J. Carmichael, Department of Munitions and Supply, Ottawa, Ontario. Accompanying the samples were two letters to Mr. Carmichael from Mr. H. Howard Armstrong, Vice-President and Consulting Engineer, The Tungsten Electrodeposit Corporation, Newport, Pennsylvania. These letters explained the nature of the samples and made certain claims with respect to their properties. Mr. Carmichael asked that the samples be examined with the object of checking on these claims.

Claims:

Mr. Armstrong's letter made the following claims:

1. The process used in the manufacture of the plate was covered by 26 patents, three of which were held in Canada.
2. The plate was being tested as a protection for dies and rolls used in hot and cold forming operations.
3. The possibilities of using the plate as a casting for aircraft engine crankshaft bearings would probably be investigated.

A pamphlet accompanying Mr. Armstrong's letter made the following claims:

1. The plate was highly resistant to acid attack, being practically unaffected by aqua regia.
2. Carbided plate is extremely hard, tough, and non-erosive.

Mr. Armstrong also suggested that the life of gun barrels might be increased if they were protected by tungsten-nickel plate.

Patent Situation:

Canadian Patents Nos. 372111, 379321 and 381063 have been taken out to cover this plating process. The first, a general patent, covers the same ground as does U. S. Patent No. 2145745, while the second, another general patent, has approximately the same coverage as U. S. Patents Nos. 2160321 and 2160322. The third patent covers the application of the process to the plating of spark plugs, similar claims

(Patent Situation, cont'd) -

being made in U. S. Patent No. 2143857.

The U. S. patents were assigned to the Tungsten Electrodeposit Corporation by Messrs. Armstrong and Menefee, the co-inventors.

Hardness Tests:

Hardness tests were made on the material as received and on plate that had been carburized at 1650° F. for 8 hours by the pack method. The carburized plate was tested both in the slowly cooled condition and in the quenched condition. The Vickers method, with a 5-kilogram load, was used in all cases. The following results were obtained, the Vickers numbers listed being approximately equivalent to Brinell hardness numbers:

Sample		V. P. H.
As received	-	350
Carburized, slowly cooled	-	200
Carburized, quenched	-	274

Corrosion Tests:

The samples submitted were too small for any satisfactory corrosion tests. The material, however, was definitely attacked by aqua regia.

Microscopic Examination:

Sections cut from each specimen were mounted in bakelite. They were then given a metallographic polish and examined under the microscope. Figures 1 and 2, at X100 magnification, show respectively the photomicrographs

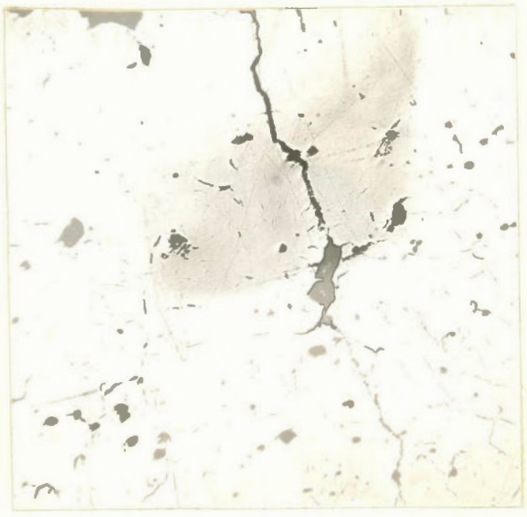
(Microscopic Examination, cont'd) -

obtained from the thin and thick sheets. The first photomicrograph shows the brass sheet on which the tungsten-nickel was plated. There is no evidence of any base plate in the second photomicrograph, which indicates that this sample, which is considerably rougher than the sample from which the first photomicrograph was obtained, is all plate material. The plate of both samples is badly cracked and not entirely sound in the uncracked regions. This cracking may have occurred in the preparation of the sample.

Figure 1.

X100, unetched.
BRASS SHEET.

Figure 2.



X100, unetched.
STEEL SHEET.

Discussion of Results:

The process is adequately protected by U. S. and Canadian patents.

It was not possible to check the claims made with respect to the corrosion resistance of the material. One claim, i.e. that the material was practically unattacked by aqua regia, definitely could not be substantiated.

The "as received" material was fairly hard and

(Discussion of Results, cont'd) -

probably would have good wear resistance. Owing to the small size of the samples it was not possible to make a full investigation of the carburized plate. Evidently the plate cannot be carburized by the conventional pack carburizing method, a special heat treatment being required to develop the hardness of the plate. Certainly, plate carburized and heat-treated by conventional methods does not possess high hardness and probably would not give any exceptional resistance to wear.

The plate examined was badly cracked and in this condition would very probably not give good protection against corrosion or wear. It is entirely possible that the cracking may have been caused in sample preparation. If this is so, such cracking might also occur in many service applications.

Conclusions:

The samples submitted were too small to allow any definite conclusions to be drawn. Corrosion and hardness tests indicate, however, that the claims of the inventors are not likely to be substantiated, as the plate is readily attacked by strong acid and has not sufficient hardness to indicate high resistance to abrasion. The bad plate cracking revealed by microscopic examination shows either an original unsoundness of this plate or a brittleness in the casing material. If this condition is inherent in the plating the casing would certainly give poor protection against corrosion and erosion. If the cracking of the plate indicates brittleness, this limits the field of application.

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