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of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1397.

IR 1397

Examination of a Scored Cheetah Aircraft Cylinder Sleeve and an Aluminium Alloy Piston.

(Copy No. 12)

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BUREAU OF MINES
DIVISION OF METALLIC MINERALS
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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:

On April 21st, 1943, W/C A. J. Smith, on behalf of the Chief of Air Staff, Department of National Defence for Air, Ottawa, Ontario, submitted for examination a Cheetah aircraft cylinder sleeve and an aluminium alloy piston, together with a sample of fine shot used for surface peening. The piston submitted had seized in service. It was thought that this may have occurred as a result of shot, used in shotblasting the cylinder head, becoming embedded in the piston through improper cleaning of the work. An examination was requested in order to determine whether this was the case.

Macro-Examination:

The piston and cylinder both appeared to be badly scored. However, no cracks were observed in either piston or cylinder sleeve. Small bright spots, which appeared to be embedded metal, were observed on the piston surface.

Microscopic Examination:

Specimens of the piston, cylinder sleeve, and shot were mounted in bakelite, polished, and examined under the microscope. Figure 1 is a photomicrograph, at X40 magnification, of a section of the cylinder sleeve after etching in a solution of 4 per cent picric acid in alcohol. The outer black area is bakelite, the dark etching material is the steel cylinder, and the white area is the chromium metal plate on the cylinder wall.

Figure 2 is a photomicrograph, at X100 magnification, showing the nital-etched structure of the metal shot used in shotblasting the cylinder head. This material is white iron.

Figure 3 is a photomicrograph, at X100 magnification, obtained from a location which showed a shiny spot area. Several particles of white iron shot may be seen embedded in the aluminium alloy piston.

Figure 1.

X40, etched 4 per cent picral.

PHOTOMICROGRAPH SHOWING CHROMIUM PLATE ON STEEL CYLINDER SLEEVE.

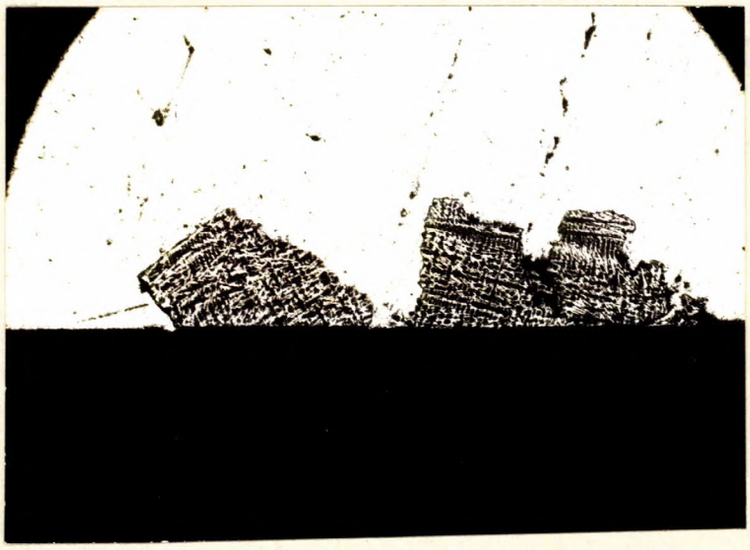
(Microscopic Examination, cont'd) -

Figure 2.

X100, etched in 2 per cent nital.

STRUCTURE OF METAL SHOT USED IN SHOTBLASTING.

Figure 3.



X100, etched in 2 per cent nital.

PHOTOMICROGRAPH SHOWING PARTICLES OF WHITE IRON SHOT EMBEDDED IN ALUMINIUM ALLOY PISTON.

Discussion of Results:

The chromium plate on the Cheetah cylinder sleeve was observed to be quite uniform and was not of the porous type of plate produced by the Van der Horst process. The thickness of the chromium plate was approximately 0.025 inch.

The shot examined was found to be of white iron (which has a Brinell hardness of approximately 450). This hard substance, when used for cleaning the cylinder head, apparently became embedded in the piston, as shown in Figure 3. It is concluded, from this examination, that the seizure of the piston was probably due to the presence of this material in the piston.

If shotblasting of the cylinder head is necessary, malleable iron shot should be used in place of the white iron shot. J. O. Almen, a leading U.S. authority on shot-blasting, states that shot size should be between 0.040 and 0.060 inch. It is his opinion, however, that shotblasting the cylinder head does not effect much improvement, other than cleaning, if the engine is air cooled but is of value for liquid-cooled engines.

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