FILE COP

OTTAWA September 19th, 1940.

REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 896.

Report on a Military Truck Hub, for D.C.I.A.(G), Department of National Defence, Ottawa.

BUREAU OF MINES
DIVISION OF METALLIC MINERALS

ORE DRESSING AND
METALLURGICAL LABORATORIES

CANADA

DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

O T T A W A September 19th, 1940.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 896.

Report on a Military Truck Hub,
for D.C.I.A.(G).

Origin of Problem and Nature of Investigation:

On September 13th, 1940, Request No. 47, from the office of the D.C.I.A.(G), Department of National Defence, Ottawa, was issued. An examination of a military truck hub was required.

Macro-Examination:

The casting as received had apparently been taken out of an assembly. Lubricating grease was found inside the hub. The design includes four elemental shapes aligned on a common axis, as follows:

(a) Flat disk which bolts on to the wheel.

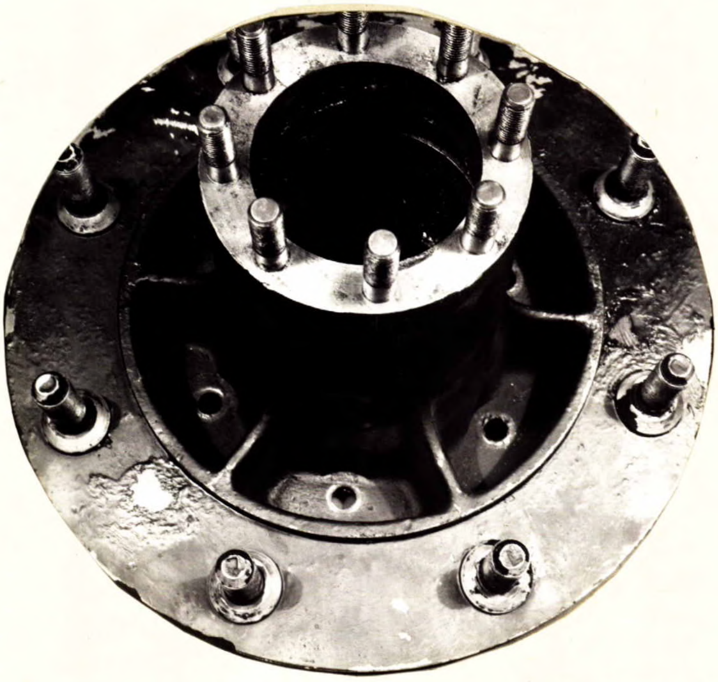
(b) Bowl connecting disk to hub.

(c) Radial ribs or webs connecting bowl to hub.

(d) Hub, a heavy cylinder shaped to hold internal bearings.

Some of the radial ribs were cracked at the point where they joined the bowl section.

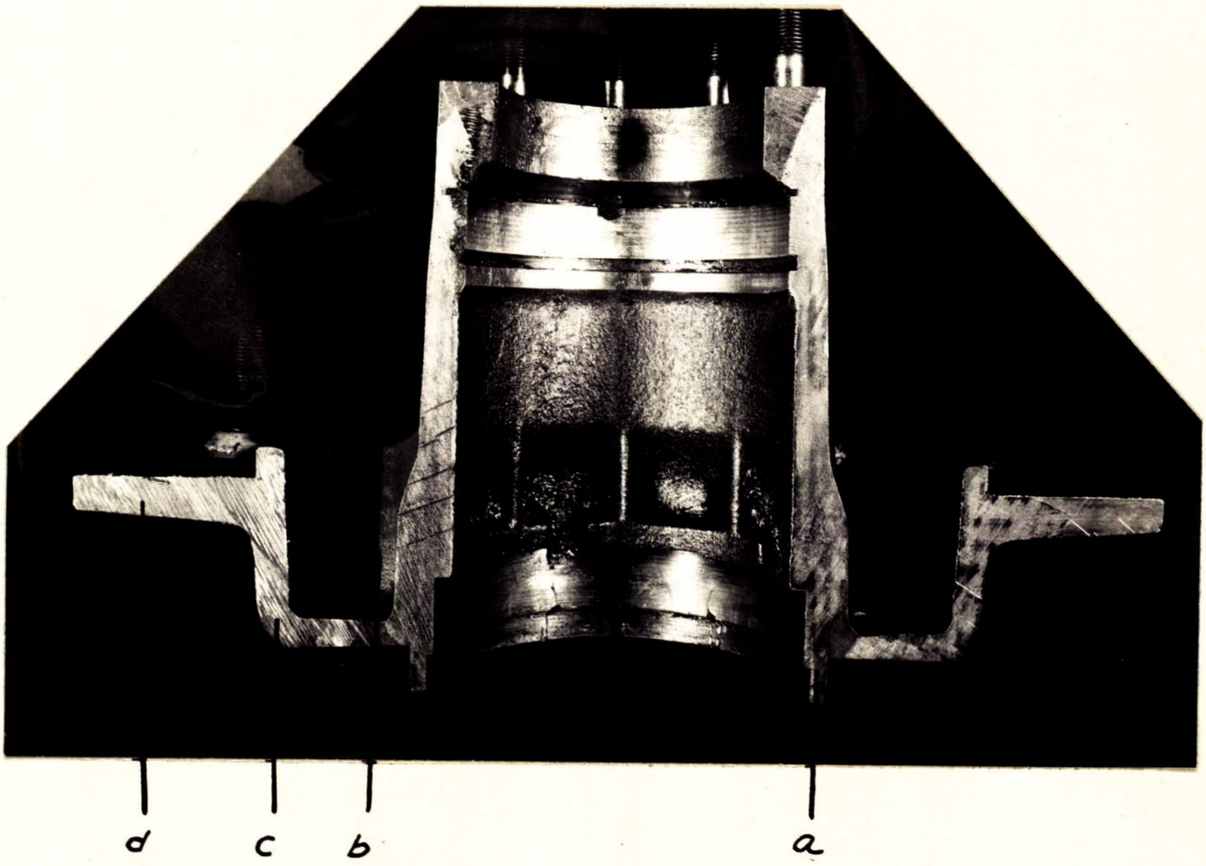
Figure 1.



Casting as received.

(Macro-Examination, cont'd) -

Figure 2.



Casting as received.

Cross-section showing:

(a) Hub.

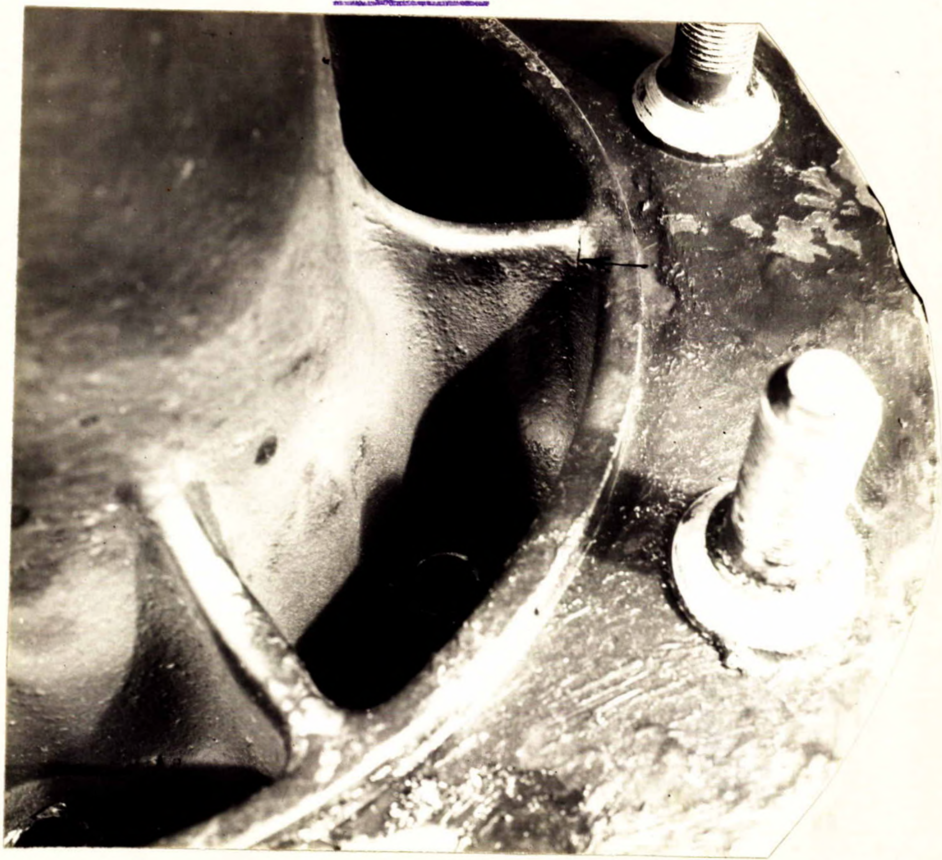
(b) Radial rib.

(c) Bowl.

(d) Disk.

(Macro-Examination, cont'd) -

Figure 3.



Casting as received, showing
cracked radial rib.

On further examination it was found that the crack shown in Figure 3 was 2 inches deep and paint was found in the fracture.

Micro-Examination:

Two pieces were cut out for micro-examination, one at the fracture and the other about 1 inch away. Figures 4 and 5 show the structure at 1 inch from the fracture.

(See next page)

(Micro-Examination, cont'd) -

Figure 4.

100X. (Nital)
At casting surface.

Figure 5.

100X. (Nital)
Centre of casting.

A pearlite rim about 0.010 inch deep is found beneath the surface decarburized layer of 0.007 inch thickness. (See Figure 4). No primary graphite is present.

Figure 5 shows the distribution of graphite nodules (black) in a matrix of free ferrite (white). The above are all indicative of fairly good quality malleable iron.

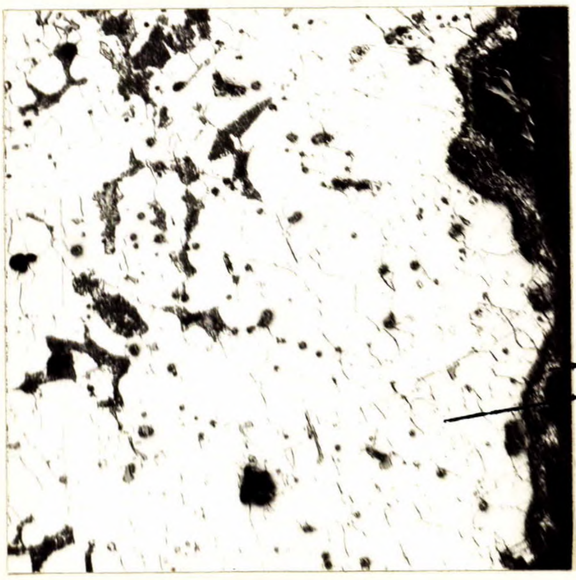


Figure 6.

100X. (Nital)
At edge of fracture, showing:
(a) Paint.
(b) Decarburization.

The fractured surfaces were decarburized during

(Micro-Examination, cont'd) -

annealing and then painted over in the final assembly.

Chemical Analysis:

		Per cent
Manganese	-	0.34
Sulphur	-	0.112
Silicon	-	1.46

Physical Tests:

A section was removed from the hub parallel to the longitudinal axis. The section under test was 0.190 inch by 0.314 inch and 3 inches long. Results were:

Elongation	=	9 per cent in one inch.
Yield point	=	37,000 p.s.i.
Tensile strength	=	49,500 p.s.i.

This was not a standard test specimen, but it served to show that the metal has fairly good physical properties.

DISCUSSION:

The cracks in the casting were big enough to be noticeable even to an unskilled inspector. It must be assumed that this casting left the foundry without being inspected. Due to the nature of foundry operations, from 0.5 per cent to 10 per cent of the castings made are not perfect. It is expected that the inspection department of the foundry will examine all castings carefully and allow only perfect castings to leave the foundry.

The microstructure of the metal shows it to be

(Discussion, cont'd) -

better than average malleable iron. The pearlite rim is nearly always associated with complete absence of primary graphite.

Chemical balance is satisfactory for this product. The desired chemical balance is:

$$\frac{\text{Manganese}}{\text{Sulphur}} = \frac{3.2}{1} \quad \text{(per cent)}$$

Carbon = 2.50 ± 0.10 per cent

Silicon = 1.50 ± 0.10 "

The standard physical tests on malleable iron are obtained on an unmachined cast bar. The test piece used herein was machined all over. Therefore the results can only be considered as indicative. Decarburization of a test bar increases the elongation.

It is obvious that the cracks occurred where a thin section joined a heavy section in the casting. Apparently the radial rib solidified before the bowl and disk section. The difference in contraction rates between the rib and the bowl set up forces which were great enough to crack the casting. In order to eliminate this difficulty, foundry practice must be altered in one or more of the following ways:

(A) Change the casting design so that the ribs are thicker.

(B) Cast "cracking strips" to strengthen the casting when hot. These strips or fins are removed before the casting leaves the foundry.

(Continued on next page)

(Discussion, cont'd) -

(C) Leave the casting in the sand longer before shaking out.

(D) Use a cooling oven to allow the castings to cool slowly to room temperature.

(E) Maintain hot strength of cores and moulding sand as low as possible.

(F) Distribute chills around the casting so as to obtain more uniform cooling.

(G) Gate the casting so that the distribution of heat throughout the casting will result in more uniform cooling.

(H) Pouring temperature and pouring time should be adjusted so as to get the minimum scrap.

-

<u>Conclusions:</u>

This casting should not have been passed by the foundry inspection department.

Cracks such as shown herein are the result of faulty foundry practice.

This design can be changed so that it is easier to cast.

The physical properties of the metal are satisfactory.

oooooooooooo
oooooo
oo

HHF:PES.