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R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1359.

Examination of a Broken New Canadian
Dry Pin Track Link.

(Copy No. 18.)

BUREAU OF MINES
DIVISION OF METALLIC MINERALS

ORE DRESSING AND
METALLURGICAL LABORATORIES

CANADA

DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

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Origin of Material and Object of Investigation:

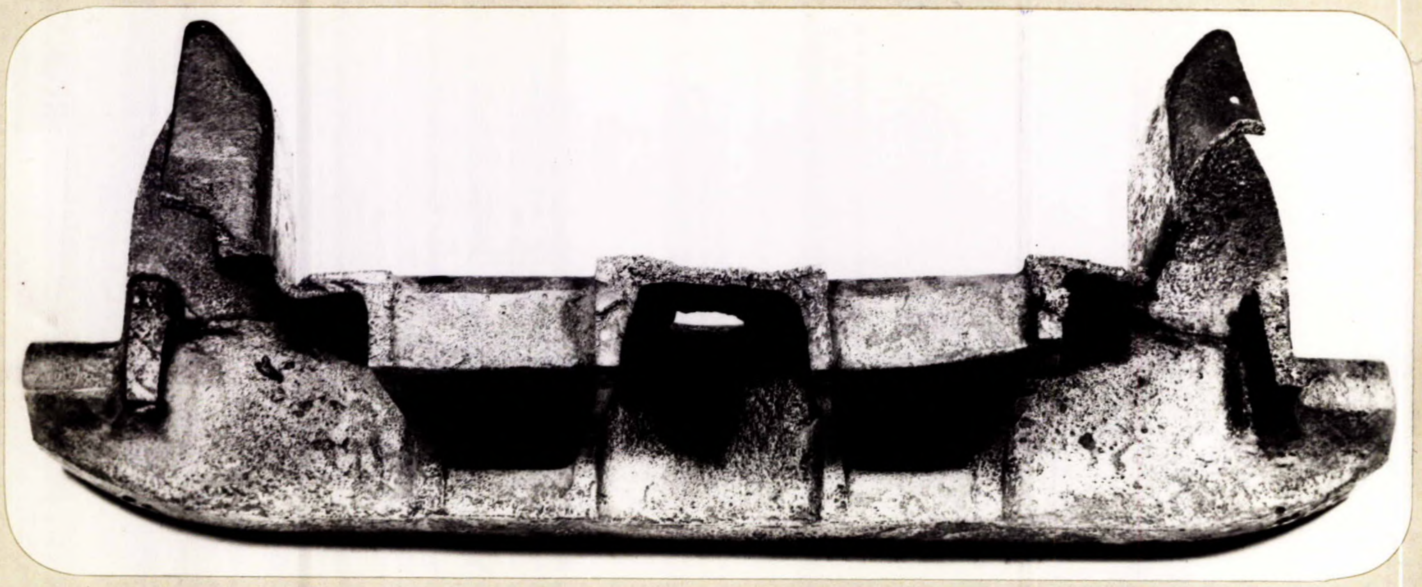
On February 19th, 1943, Mr. V. W. G. Wilson, for Director General, Army Engineering Design Branch, Department of Munitions and Supply, Ottawa, Ontario, submitted a new Canadian dry pin track link for examination. It was reported that this link had failed during a field test at approximately 150 miles. The link was produced by the Hull Iron & Steel Foundries Limited, Hull, Quebec.

Macro-Examination:

Figures 1 and 2 illustrate the condition of the failed link. Figure 1 shows that the three-eye side of the link has been ripped off. Figure 2 is taken of the ground contact face of the link. It is interesting to note that one of the ribs has been forced apart during the failure.

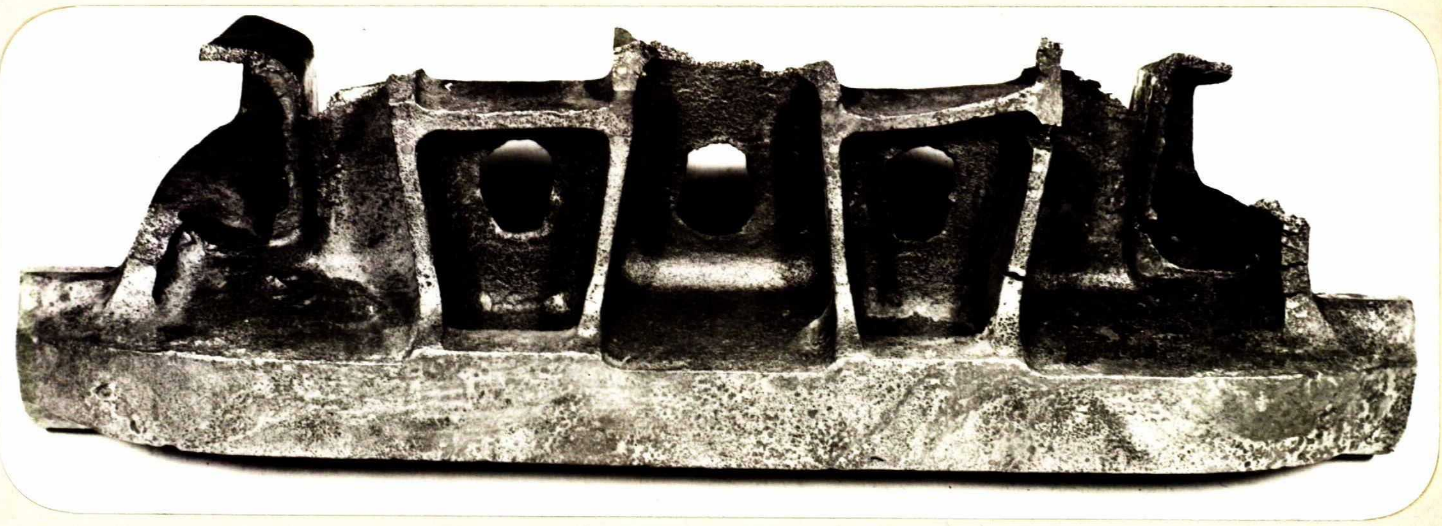
Figure 3 illustrates the thinness of section at the base of one of the grinding lugs, where it is quite likely that the failure may have first started. The diameter of this section should be 3/8 inch. It is only 1/16 inch.

Figure 1.



FAILED SHOE.
(Approximately ½ size).

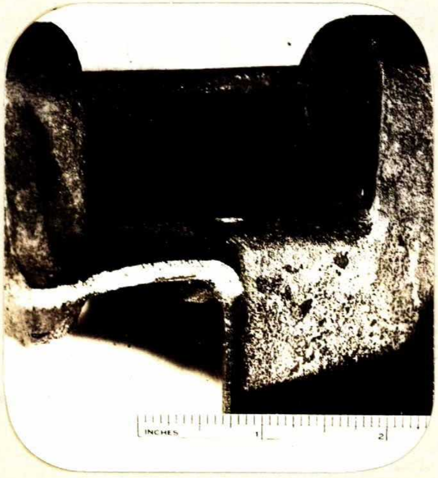
Figure 2.



GROUND CONTACT FACE OF FAILED SHOE.

(Approximately ½ size).

Figure 3.



DIAMETER OF SECTION 1/16 INCH INSTEAD OF 3/8 INCH.

Chemical Analysis:

Drillings were taken from the link for chemical analysis:

		As found	Recommended Specification
		- Per cent -	
Carbon	-	0.93	1.00 - 1.40
Manganese	-	11.25	10.00 - 14.00
Silicon	-	0.47	0.30 - 1.00
Phosphorus	-	0.083	0.10 max.
Sulphur	-	0.025	0.05 max.

Hardness:

The Brinell of the link was 187.

Bend Tests:

The grouser of the failed link was cut off and subjected to a bend test, using a 1-inch radius and 4-inch centres. The sample failed at approximately 40° but the fracture showed that a shrinkage cavity was present. A coarse grain size was evident. An unused link of the same design was obtained from the foundry and its grouser was subjected to the same test. A 145° (approx.) angle was obtained, showing that this link had a good ductility.

Microscopic Examination:

Specimens of the link were cut and polished. The unetched specimens showed that the steel was reasonably clean. Figure 4, taken at X100 magnification of a nital-etched specimen, illustrates the structure of the link. Microshrinkage cavities and a coarse grain size are evident.

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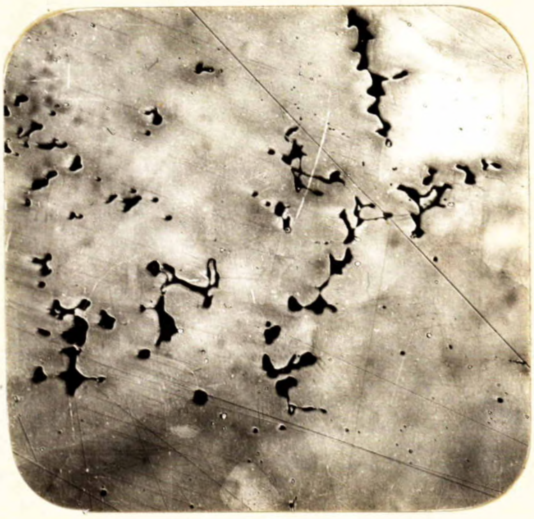
(Microscopic Examination, cont'd) -

Figure 4.



X100, nital etch.

STRUCTURE OF LINK

Note large grain size and microshrinkage cavities.

Discussion:

The chemical analysis indicates a lower carbon than is usually used in a high-manganese steel. The main effect of this is to lower the wear resistance slightly.

The bend test was of little value, due to the fact that the specimen broke at a shrinkage cavity.

The thin section at the base of the lug was most likely caused by a shifting of the core.

The large grain size indicated in the photomicrograph results in a lowering of the tensile strength by about 20 per cent (15,000 to 20,000 p.s.i.). This coarse grain size is produced by a high pouring temperature. The microshrinkages would also lower the strength of the casting somewhat.

The metal is not of the highest quality. It can be expected, however, in the production of high-manganese steel that this type of material will be encountered from time to time. It is therefore necessary that the casting design should

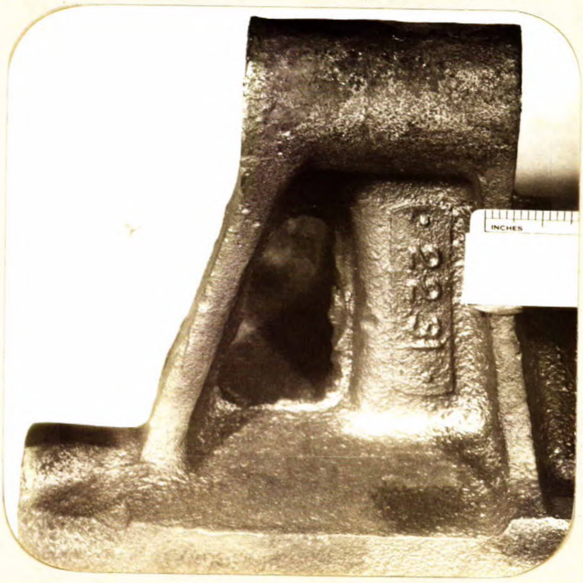
(Discussion, cont'd) -

allow for a reasonable margin of safety. In this connection, the foundry has already submitted a casting with ribs of wider diameter. Figure 5 illustrates the diameter of the rib as at present on field test. It is about 7/32 inch. Figure 6 shows the new rib. This is 12/32 inch in diameter. It is felt by the firm that this will greatly improve the strength of the link at one of its weakest sections.

In the case of the link examined in this report, it is felt that the thin section at the base of the lug, combined with steel which is not of the optimum quality, was most likely responsible for the early failure of the link. Shifting of the core, which resulted in the thin section, would be a very rare occurrence once the foundry is set up for production.

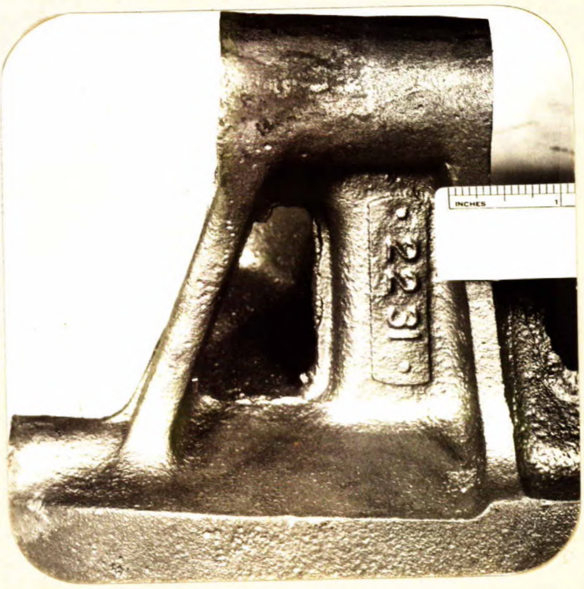
In order to eliminate cavities, the casting technique would have to be altered.

Figure 5.



LINK WHICH IS ON FIELD TEST AT PRESENT.

Figure 6.



PROPOSED LINK.

CONCLUSIONS:

1. A lower carbon is present than is usually found in a high-manganese steel. The effect is a slightly lower wear resistance.

2. A large grain size is evident. This is caused by high pouring temperature. Tensile strength would be about 20 per cent lower.

3. Microshrinkages are evident, as well as a large shrinkage cavity (shown in grouser used for bend test). Casting technique would have to be altered to eliminate this.

4. The thin section at the base of the lug has been caused by a shift in the core. This would happen only on rare occasions when proper pattern equipment is used.

5. The marginal metal that was used, together with the thin section at the base of the lug, has most likely been responsible for the failure of the shoe.

6. The design should have a greater margin of safety.

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