File.

FILE COPY

O T T A W A January 28th, 1944.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1586.

Examination of Two Track Shoe Frames.

(Copy No. 10.)

O T T A W A January 28th, 1944.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1586.

Examination of Two Track Shoe Frames.

Origin of Material and Object of Investigation:

On January 12th, 1944, two track shoe frames (Analysis Requisition No. O.T. 4120) were submitted by Mr. J. M. Gilmartin, I.O.M., Inspection Board of United Kingdom and Canada, Ottawa, Ontario. An accompanying memorandum from Mr. F. C. Wilson, I.O (Tanks), stated that the frames represented a lot from which the rubber had been removed by heating, and requested an examination to determine the extent of decarburization which had resulted from this treatment.

Hardness Survey:

Transverse sections were cut from the tubes and end connectors of each link at the points marked A, B, C and D in Figure 1.

Hardness surveys were made across these sections, using a Vickers hardness testing machine with a 10-kilogram load. Hardness values were plotted against their distance

(Hardness Survey, cont'd) -

from the surface and values at various increments of distance were scaled off the curve and are shown in Tables I and II.

Surface hardness measurements were not attempted because the surfaces of both links were badly scaled. Readings taken under such conditions would have supplied very little additional information and, if inaccurate, would have been misleading.

TABLE I. - LINK FRAME NO. 2.

Section	VICKERS HARDNESS NUMBER (10-kg. load) Distance from Surface (in inches) Inside .01	.02	.03	.04	.05	.10	.15	.20	Outside .20	.15	.10	.05	.05	.03	.02	.01
A	268	310	309	310	310	310	310	310	310	310	310	310	310	310	242	222
B	188	306	310	310	310	310	310	310	310	310	310	310	310	310	300	209
C	209	260	317	317	317	317	317	317	320	317	320	320	320	320	317	170
D	200	255	315	315	315	315	316	317	317	317	320	320	320	320	320	188

TABLE II. - LINK FRAME NO. 5.

Section	VICKERS HARDNESS NUMBER (10-kg. load) Distance from Surface (in inches) Inside .01	.02	.03	.04	.05	.10	.15	.20	Outside .020	.15	.10	.05	.05	.03	.02	.01
A	189	330	330	330	330	322	330	350	322	330	330	330	330	330	330	294
B	306	333	333	333	333	333	330	330	330	330	333	333	333	333	333	189
C	266	330	360	363	363	363	363	363	363	363	363	363	363	363	363	228
D	259	327	327	327	327	327	327	327	327	327	327	327	327	327	328	236

Microscopic Examination:

Microscopic examination was made of specimens cut from the same locations, and the depth of the decarburized zone at both the inside and outside surfaces was measured visually at a magnification of 500 diameters. The results are shown in Table III. One specimen was annealed in lead at 1500° F. and cooled in lime to produce a pearlitic structure in which the ferrite of the low-carbon areas would be more visible. The depth of decarburization was again measured and measurements checked with those shown in Table III.

TABLE III.

	DEPTH OF PARTIALLY DECARBURIZED ZONE, in inches							
	LINK NO. 2				LINK NO. 5			
	A	B	C	D	A	B	C	D
Inside surface)	0.011 -0.012	0.008 -0.012	0.008 -0.012	0.008 -0.012	0.008 -0.011	0.006 -0.007	0.005 -0.008	0.006 -0.007
Outside surface)	0.011 -0.012	0.008 -0.012	0.008 -0.011	0.006 -0.007	0.006 -0.007	0.006 -0.007	0.006 -0.007	0.006 -0.007

Typical microstructures at the surface and centre of a section are shown in Figures 2 and 3 respectively. Both photomicrographs are at 500 magnifications. The white areas in Figure 2 are ferrite, the dark areas drawn martensite. The white constituent, ferrite, is produced as a result of decarburization. All areas in Figure 3 are drawn martensite. The microstructure of the specimen which was annealed in lead is shown in Figure 4; the white areas are ferrite and the dark areas carbon-poor pearlite.

Discussion:

Hardness surveys and microscopic examination substantiate each other in showing a partially decarburized zone at the surface. Microscopic examination is the more accurate method for

(Discussion, cont'd) -

measuring the depth of this zone and measurements taken in this way show a depth of 0.005 to 0.012 inch.

The presence of a tempered martensitic structure (which is obtained by a quenching and drawing heat treatment) across the section is a definite indication that this metal has not been heated above its critical temperature while removing the rubber, for if it had been, unless an unusually high rate of cooling followed, the structure would not have been of the same type as that shown in Figure 3. This being the case, extensive decarburization would not be expected. Indeed, it is practically certain that the partially decarburized zone observed had been produced during some previous heat-treating operation.

Past experience has shown that Ram Tank track pins in service are subject to failures at the pin ends, i.e., in the same location as the end sections of the links. It is notable that shotblasting the ends of the pin reduced these failures, indicating that they were caused by the action of alternating stresses. If these sections are subject to such stresses, it is important that the surface fibre of the metal be in the best possible condition to resist them, and a partially decarburized zone at the surface might well be harmful. However, this could only be determined definitely by field tests.

If reheat treatment is considered necessary some method of controlled recarburization, such as outlined in O.D.M.L. Report of Investigation No. 1573 (January 18th, 1944), is advisable, provided the facilities are available.

Before any reheat treatment is attempted, the scale should be removed from the link surface by sandblasting, tumbling or some similar method.

CONCLUSIONS:

1. The track link frames are partially decarburized to a depth of 0.005-0.012 inch.

2. It is possible that the end sections of the link are subject to high alternating stresses. To resist these, the surface of these parts should be free from partial decarburization. This possibility can only be checked by field tests.

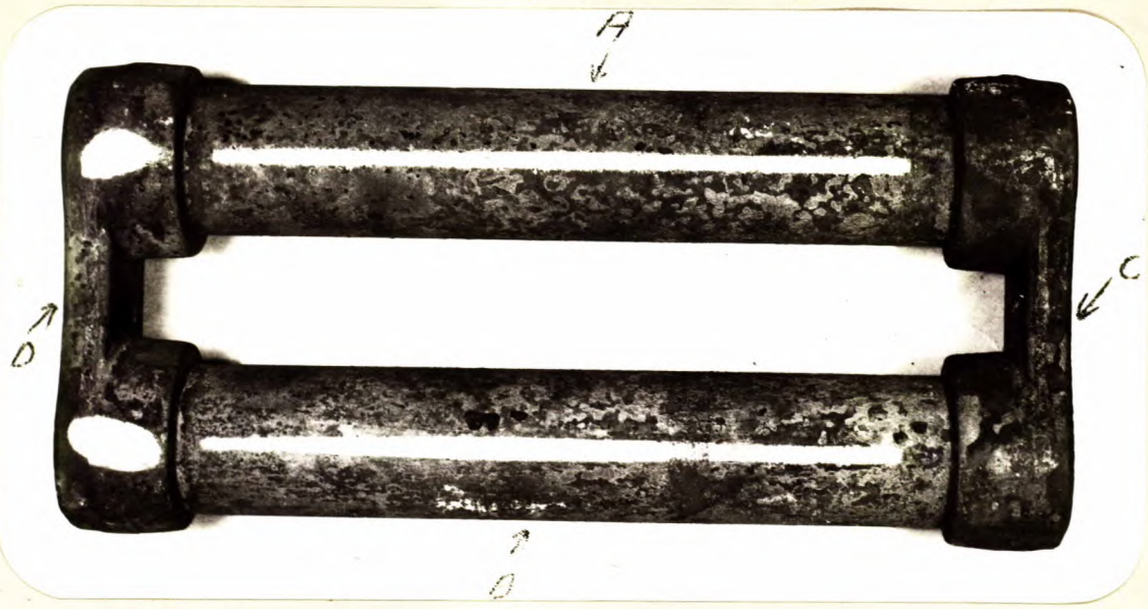
3. If reheat treatment is considered necessary, some method of controlled recarburization is advisable should the facilities be available.

4. Before any heat treatment is attempted, scale should be removed from the surface.

oooooooooo
ooooooo
ooo
o

IHM:CHB.

Figure 1.



RAM TANK TRACK LINK FRAME.

—

Figure 2.

X500, etched in 2 per cent nital.
PARTIALLY DECARBURIZED ZONE.
Ferrite and low-carbon martensite.

—

Figure 3.

X500, etched in 2 per cent nital.
TEMPERED MARTENSITE.

—

Figure 4.

X500, etched in 2 per cent nital.
FERRITE AND CARBON-POOR PEARLITE.

—

IHM:GHB