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O T T A W A June 28th, 1945.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1437.

Examination of Two Ram Tank Volute
Springs, Reconditioned.

(Copy No. 10.)

Bureau of Mines
Division of Metallurgical
Minerals
Ore Dressing
and Metallurgical
Laboratories

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
Mines and Geology Branch

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Origin of Request and Nature of Material:

On June 18th, 1943, under Requisition No. 546, A.E.D.B. Lot No. 335, Prof. J. U. MacEwan, Consultant to the Director of Metallurgy, Army Engineering Design Branch, Department of Munitions and Supply, Ottawa, Ontario, submitted two reconditioned Ram tank volute springs (design, AEEDB Drawing C-95163) for examination. These springs, which in this report are designated "A" and "B", had been supplied by the Cozens Spring Service and Manufacturing Co. Ltd., 157 Queen Street East, Toronto, Ontario.

Information Desired:

1. Permanent set after bottoming.
2. Microstructure.
3. Longitudinal and transverse hardness surveys.
4. Amount of decarburization present.

Identification of Springs:

The spring designated "A" was marked as follows:

PGE - C 73927
ORD - 40009-13
HT 55L415

The spring designated "B" was marked thus:

PGE - C 73927
ORD - 39
HT 55L584

Vertical strips were cut from the springs, as follows:

<u>Strip No.</u>	<u>Spring</u>	<u>Position</u>
1	A	Bottom coil
2	A	Middle "
3	A	Top "
4	B	Bottom "
5	B	Middle "
6	B	Top "

Permanent Set:

Spring "B" had a permanent set of $\frac{5}{8}$ inch after bottoming. Spring "A" was not tested.

Hardness Surveys and Microstructures:

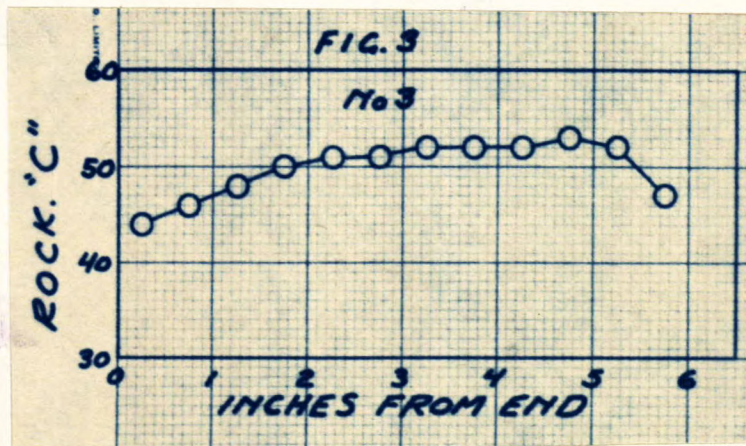
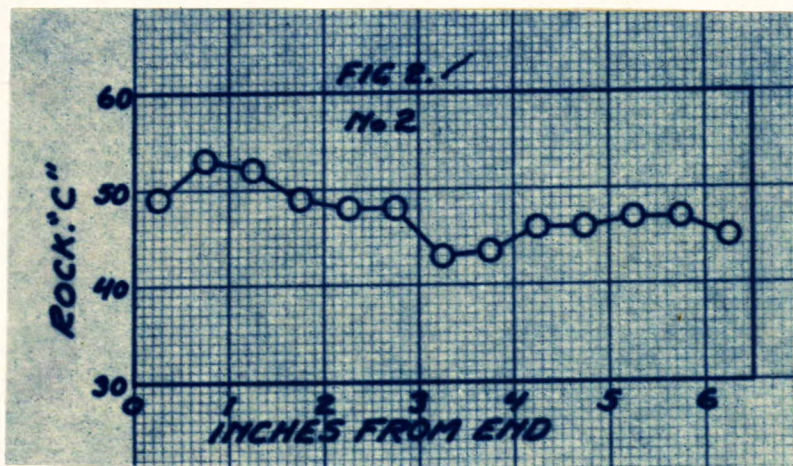
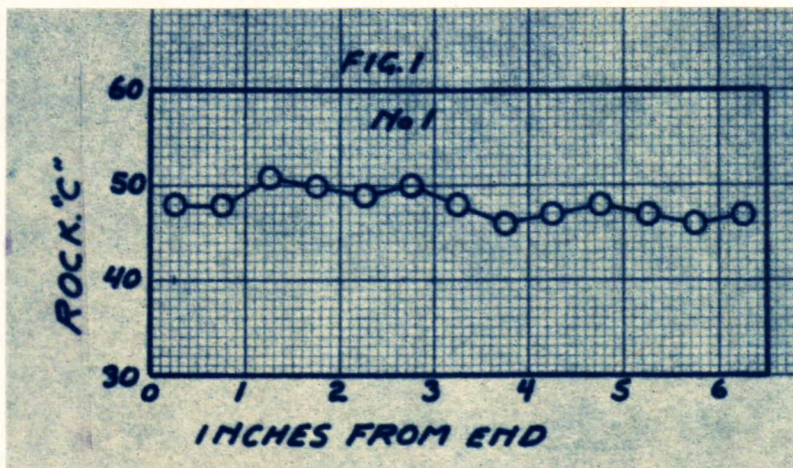
Information on these points is given in Figures 1 to 12, charts and photomicrographs appearing on the next six pages. Springs "A" and "B" are each taken in turn.

(Pages 3 to 8 contain
(Figures 1 to 12 inclusive)

(Hardness Surveys and Microstructures, cont'd) -

"A" SPRING.

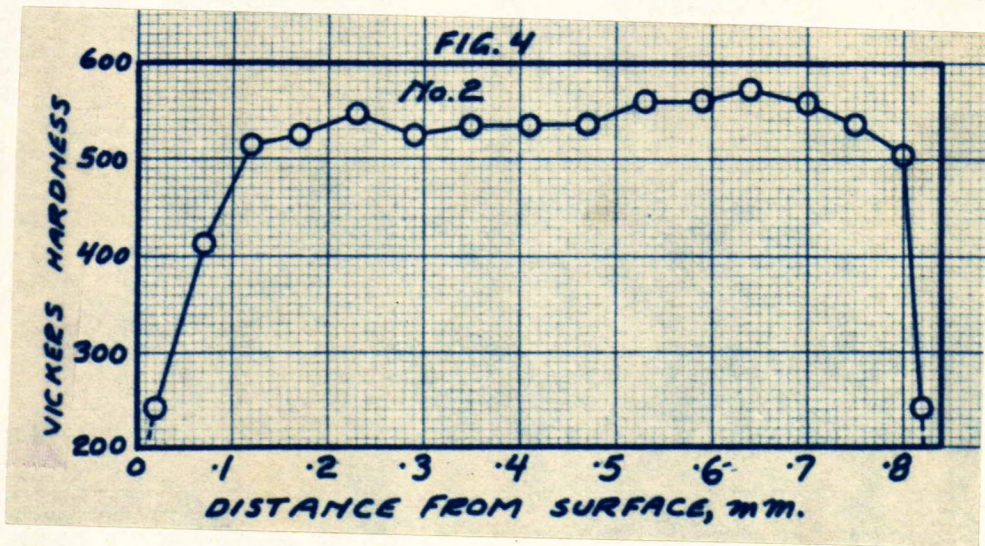
HARDNESS SURVEY, EDGE TO EDGE.



(Hardness Surveys and Microstructures, cont'd) -

"A" SPRING.

HARDNESS SURVEY, SURFACE TO SURFACE.

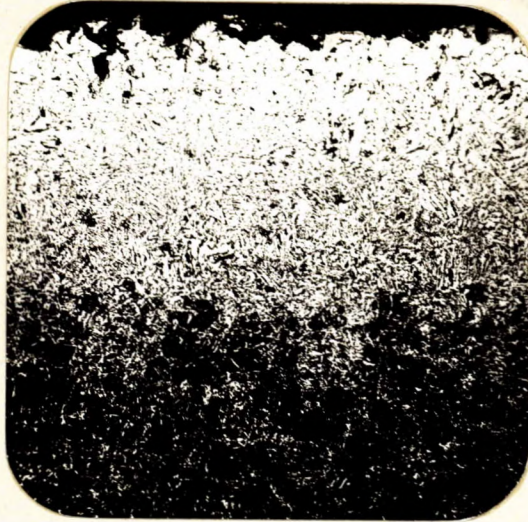


(Hardness Surveys and Microstructures, cont'd) -

"A" SPRING.

MICROSTRUCTURE.

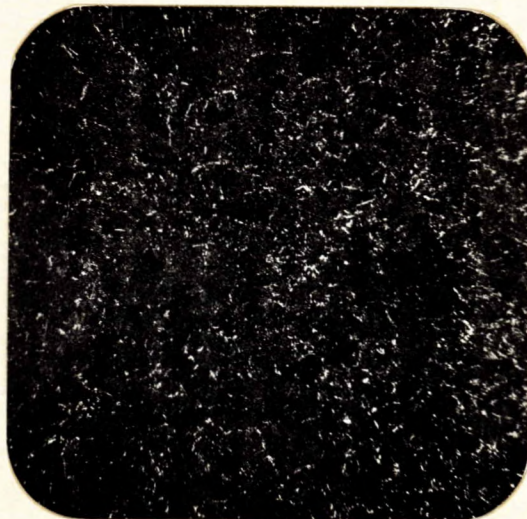
Figure 5.



X100, nital etch.

EDGE OF SPRING, SHOWING
DECARBURIZATION OF 0.015-0.020 INCH.

Figure 6.



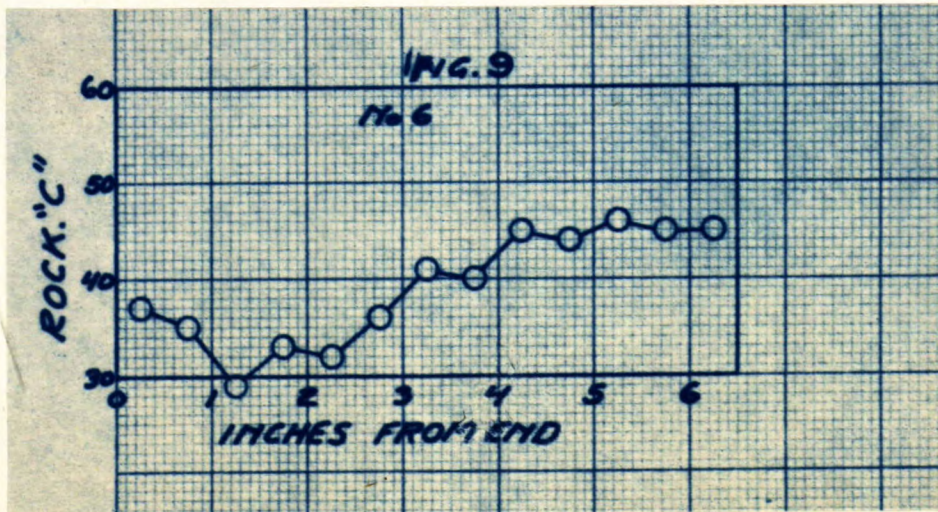
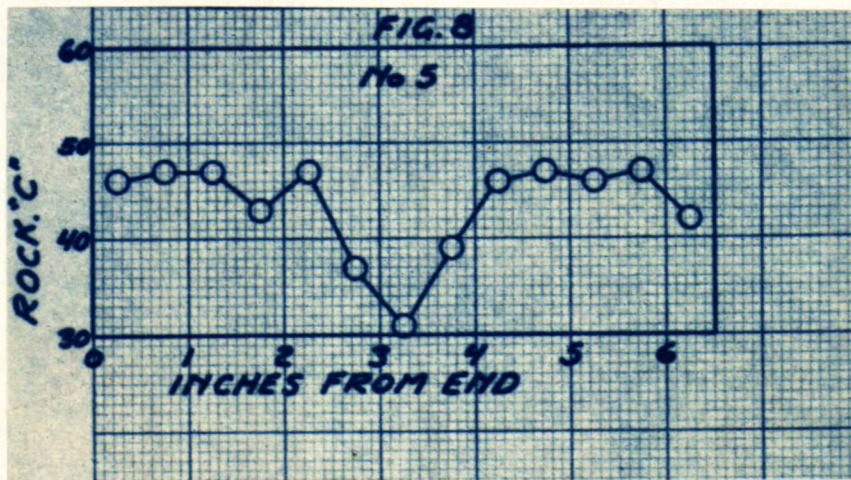
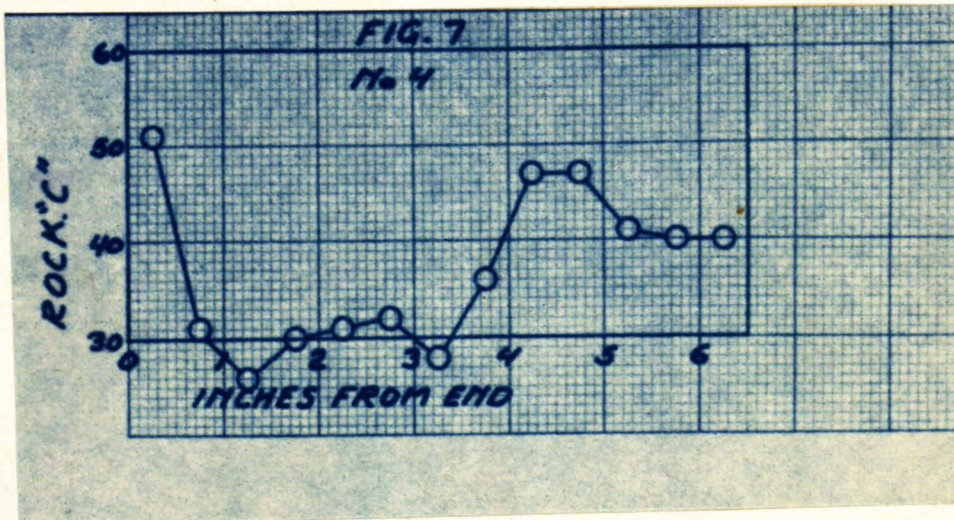
X100, nital etch.

CENTRE OF SPRING, SHOWING TRACES
OF FERRITE IN SOBITE BACKGROUND.

(Hardness Surveys and Microstructures, cont'd) -

"B" SPRING.

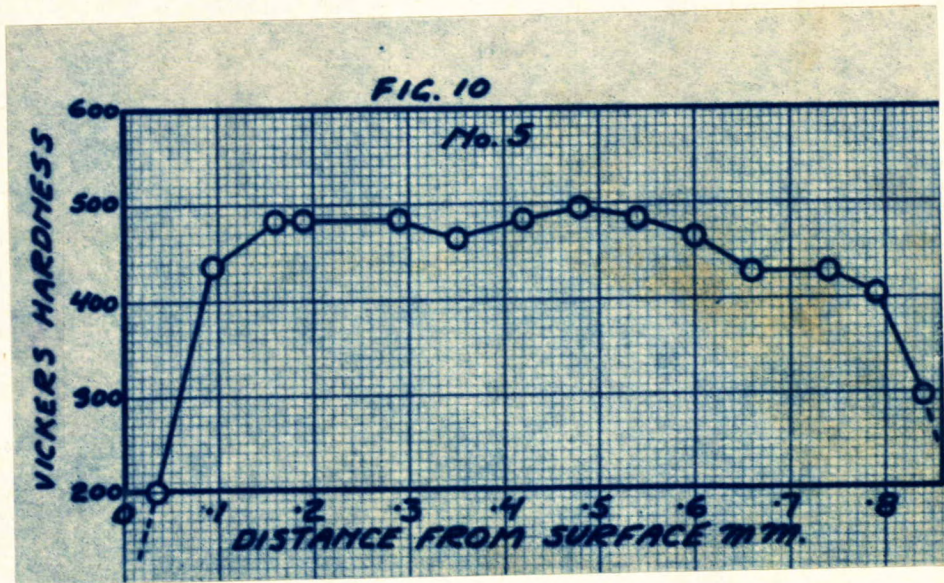
HARDNESS SURVEY, EDGE TO EDGE.



(Hardness Surveys and Microstructures, cont'd) -

"B" SPRING.

HARDNESS SURVEY, SURFACE TO SURFACE.

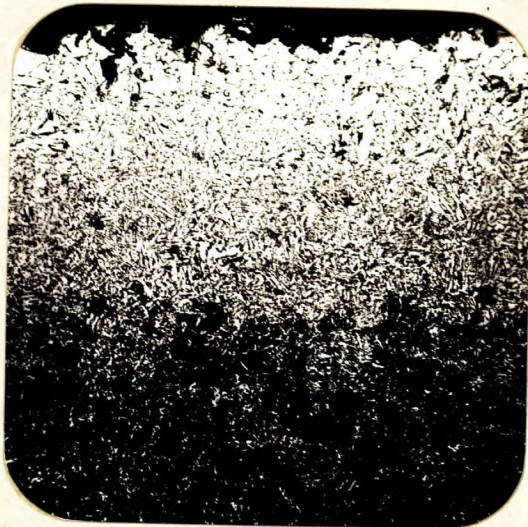


(Hardness Surveys and Microstructures, cont'd) -

"B" SPRING.

MICROSTRUCTURE.

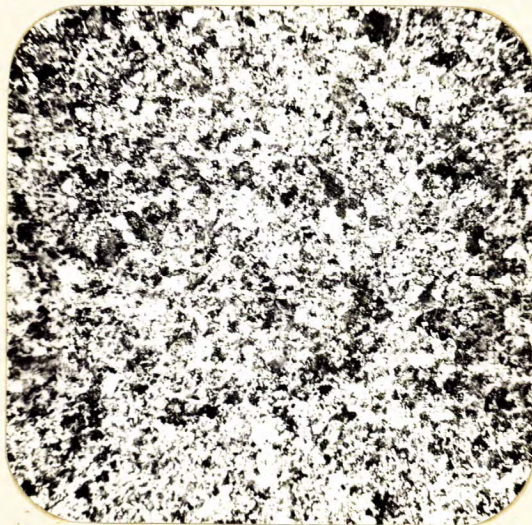
Figure 11.



X100, nital etch.

EDGE OF SPRING, SHOWING
DECARBURIZATION OF 0.015-0.020 INCH.

Figure 12.



X100, nital etch.

CENTRE OF SPRING, SHOWING A CONSIDERABLE
AMOUNT OF FERRITE IN A PEARLITE BACKGROUND.

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CONCLUSIONS:

The depth of the decarburized zones on Springs "A" and "B" varies from 0.015 to about 0.020 inch. This amount of decarburization reduces the fatigue life of the spring to less than half that of an undecarburized spring⁶. Also, Boeghold, General Motors Research, has proved that decarburized springs soon flatten out in service.

"B" spring is below the Rockwell 'C' 40 minimum hardness usually recommended for springs.

A discussion of the current information on springs and their metallurgical properties will be found in the Bureau of Mines' Report of Investigation No. 1270, August 12th, 1942.

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HNF:GHB.

⁶ The Effect of Surface Conditions Produced by Heat Treatment on the Fatigue Resistance of Spring Steels, - Hankins and Becher, (Journal of the Iron and Steel Inst., 1931, Vol. 2).