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# R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1809.

## Determination of Contraction of Parts of a Mark XXIII Gun Sight at Sub-Zero Temperatures.

(Copy No. 10.)

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Source of Material and Object of Investigation:

Under date of February 14, 1945, Mr. E. Proudfoot, Admiralty Inspector at Sawyer-Massey Company Limited, Hamilton, Ontario, on instructions from Cmdr. (E) G. Taylor, R.N.V.R., British Admiralty Technical Mission, 58 Lyon Street, Ottawa, Ontario, submitted to these Laboratories, for examination, one C.P.R. Sight Assembly #1194. In a letter accompanying the sight it was stated that the gear box, etc., contained nothing but the original grease, as supplied by the C.P.R. A sample of the grease used by Sawyer-Massey Company in the lubrication of all the sight fittings was also submitted. The British Specification for this grease was stated to be D.T.D. 143C; the grease is known in Canada as Aeroshell Grease No. 4 and can be obtained from the Shell Oil Company Limited.

Cmdr. (E) G. Taylor, R.N.V.R., in a letter (File No. 11-33-3-1) dated February 15, 1945, stated that they had a report of trouble occurring on H.M. Ships in the U.S. ports

(Source of Material and Object of Investigation, cont'd) -

due to Mark XXIII sights, made in Canada, binding in cold weather. It was requested that experiments be carried out on the sight submitted, which was taken from current production, in order to determine, if possible, the cause of the trouble.

Experimental Tests:

1. The gun sight was first tested in the "as received" condition at room and -20° F. temperatures.

At room temperature both the range and the deflection wheels operated quite satisfactorily. However, at -20° F. the deflection wheel was quite stiff.

2. The gun sight was taken apart and after removing all the grease it was re-assembled and greased with Shell Aeroshell Grease No. 4. A small bronze cutting was removed from the gear box.

At room temperature and at -20° F. the range and deflection wheels operated in the same manner as in Test No. 1.

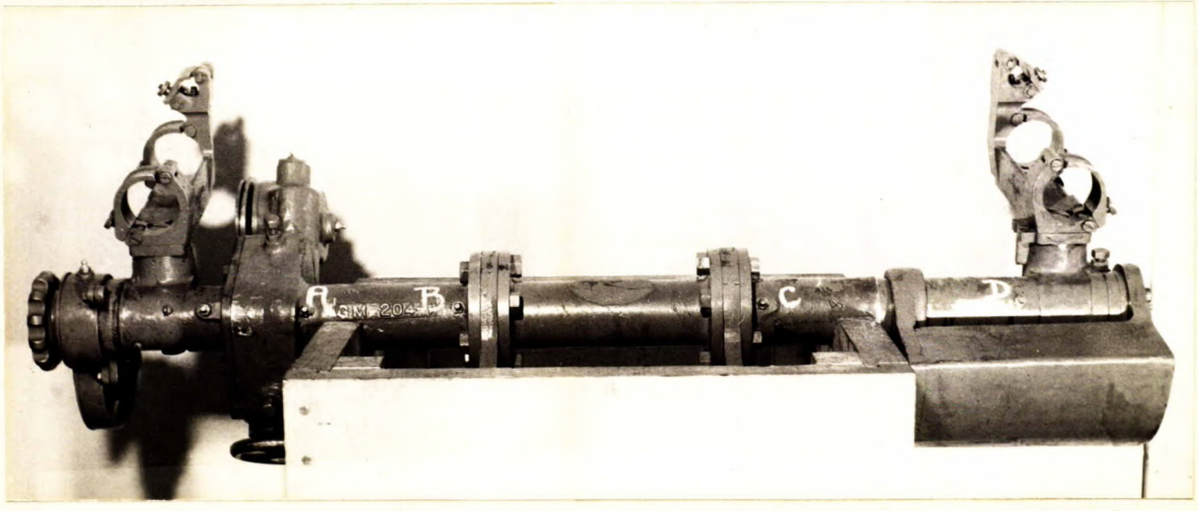
3. An inspection of the assembly was carried out in order to try to detect where the gears were binding. Several places on the bearing surfaces of the silicon-bronze casting were observed to be slightly scored and this indicated that the cause of the trouble might be due to unequal contraction of the silicon-bronze casting and the steel shaft at low temperatures.

4. Measurements were taken of the inside diameter of the bronze bearings and also the outside diameter of the steel shaft at room, -8° F., -15° F. and -20° F. temperatures, the measurements being made at points A, B, C and D shown in Figure 1.

(Continued on next page)

(Experimental Tests, cont'd) -

Figure 1.




MARK XXIII GUN SIGHT ASSEMBLY.

(Approximately 1/8 actual size).

The measurements obtained are tabulated below:

| Location of Readings | Temperature, degrees Fahrenheit | Steel Shaft, O.D., inches | Bronze Bearing, I.D., inches | CONTRACTION, in inches: Steel Shaft | CONTRACTION, in inches: Bronze Bearing |
|---|---|---|---|---|---|
| A | Room | 1.9495 | 1.9520 | - | - |
| " | -8 | 1.9480 | 1.9490 | 0.0015 | 0.0030 |
| " | -15 | 1.9480 | 1.9485 | 0.0015 | 0.0035 |
| " | -20 | 1.9480 | 1.9485 | 0.0015 | 0.0035 |
| B | Room | 1.9495 | 1.9520 | - | - |
| " | -8 | 1.9485 | 1.9490 | 0.0010 | 0.0030 |
| " | -15 | 1.9485 | 1.9495 | 0.0010 | 0.0025 |
| " | -20 | 1.9485 | 1.9485 | 0.0010 | 0.0035 |
| C | Room | 1.9495 | 1.9520 | - | - |
| " | -8 | 1.9485 | 1.9490 | 0.0010 | 0.0030 |
| " | -15 | 1.9490 | 1.9495 | 0.0005 | 0.0025 |
| " | -20 | 1.9485 | 1.9485 | 0.0010 | 0.0035 |
| D | Room | 1.9495 | 1.9520 | - | - |
| " | -8 | 1.9485 | 1.9490 | 0.0010 | 0.0030 |
| " | -15 | 1.9490 | 1.9495 | 0.0005 | 0.0025 |
| " | -20 | 1.9480 | 1.9485 | 0.0015 | 0.0035 |

5. The silicon-bronze castings (the layer and grainer

(Experimental Tests, cont'd) -

ends) and the steel shaft were placed in the cold room and tests were carried out under low-temperature conditions in order to see whether they could be re-assembled. With the cold room at temperatures of -8°, -15°, and -20° F. the bronze bearing could not be re-assembled over the steel shaft without subjecting it to considerable force.

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Conclusions:

The results of measurements taken of the steel shaft and the silicon-bronze bearings show that the silicon bronze has a greater contraction at sub-zero temperatures than the steel shaft. From these results it is concluded that this difference in contraction is the cause of binding encountered in cold weather. This trouble could be eliminated by providing for slightly greater clearances. The same procedure could also be followed in overhauling sights already installed.

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