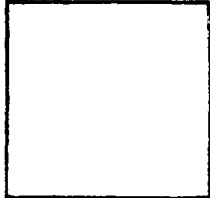


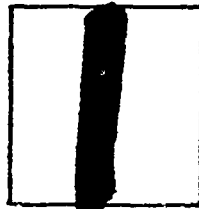
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REPORT NO. 344/46

CRACKS IN MONEL METAL

By

INDIVIDUAL

P. R. Kostig
Chemical Engineer

December 9, 1936
WATERTOWN ARSENAL
WATERTOWN, MASS.

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Report No. 344/46
Watertown Arsenal

December 9, 1936

CRACKS IN MONEL METAL

Object

To determine cause of cracks in piece 175814, clamp screw - Ex. Order 509-156.

Ex. O. - 509-A-36

Conclusions

Cracks were due to intergranular embrittlement by sulfur picked up when monel metal rod was heated for bending, in forge fire. Coal or coke fires must not be used for heating monel metal.

Material

Four clamp screws, 175814, were submitted for examination after cracks were detected on the buffed piece. These pieces were made up from 5/8" cold drawn monel metal, and were bent 70° after heating in a forge fire.

Examination

One clamp screw was sectioned, the original monel metal rod was sectioned and examined "as received" and after being

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placed in forge fire for 25 minutes (requested 15 min.)

Results

The microstructures are shown on Figs. 1, 2, and 3, these being taken by Mr. Carter. Fig. 1 shows the ruined grain boundary due to S contamination of the clamp screw; Fig. 2 shows the clean grain boundary of the original metal; and Fig. 3 shows the grain boundary contamination due to S pick up of the experimental piece placed in forge fire.

The pick up of sulfur was not uniform throughout the periphery of the metal subjected to heating in coal or coke fire. Where sulfur had been picked up the penetration was quite deep and by way of the grain boundary. Any bending, hot or cold, would cause cracking. Metal contaminated with S cannot be reclaimed except by machining off the contaminated layer.

Monel metal is very susceptible to sulfur and must not be heated in coke or coal fires, or in oil fires, from fuel running over 1/2% S.

The original 5/8" diameter bar was bent 115° without any sign of cracking. Considerable force was required to bend the bar.

Respectfully submitted,

P R Kosting
P. R. Kosting,
Chemical Engineer

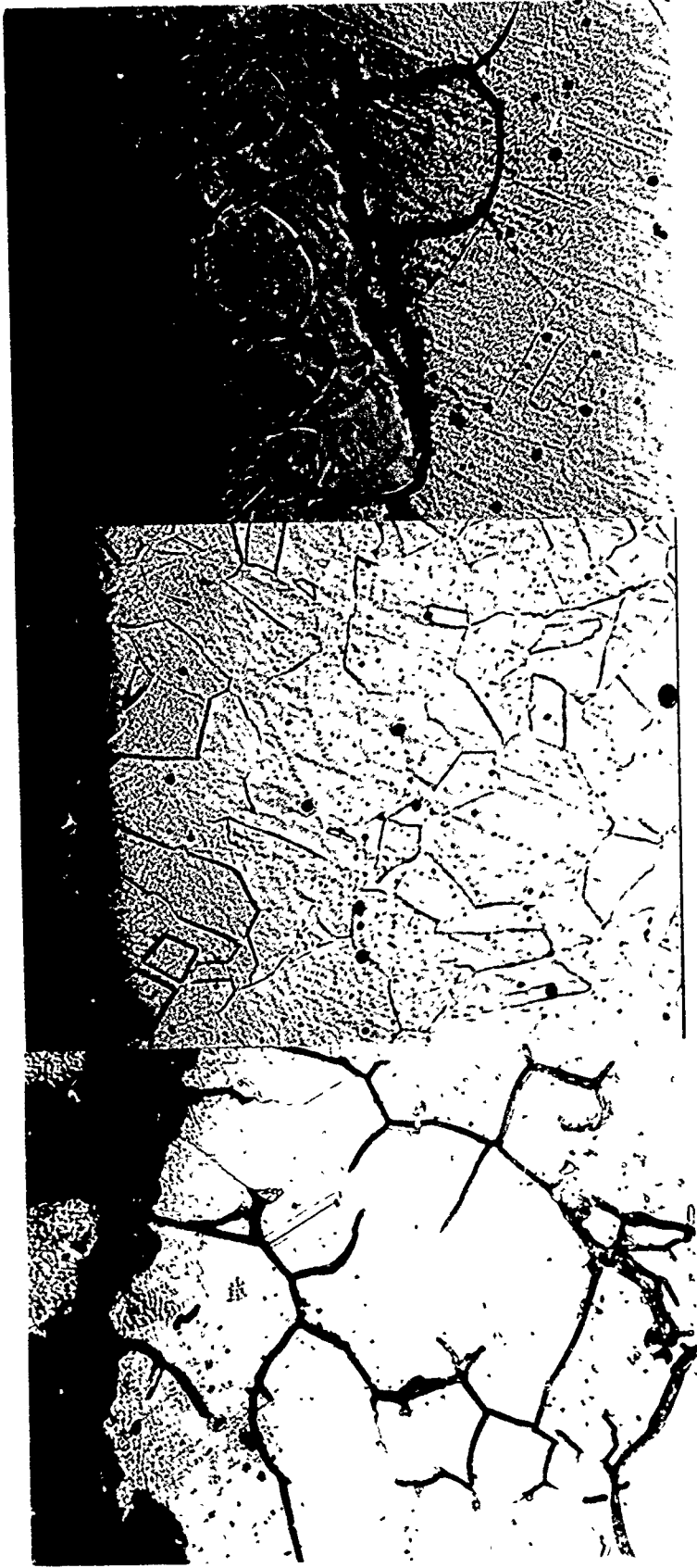


Fig. 1 MM257 x 500

Fig. 2 MM259 x 500

Fig. 3 MM258 x 500

- Fig. 1 Ruined Grain Boundaries of monel metal clamp screw 175814 due to S contamination (Long)
Fig. 2 Clear Grain Boundaries of original monel metal (Trans)
Fig. 3 Grain Boundaries contamination due to S pick up when monel metal was placed in forge fire (Trans)

All etched HNO₃ + HAC50:50.

Edge of specimen on top.