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Push-pull fatigue properties of wires in an iridium - 5% tungsten alloy

- by -

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Introduction

The Materials Department at Cranfield was approached by the Platinum Metals Division of the International Nickel Co. with a view to carrying out a preliminary survey of the fatigue properties of an iridium-5% tungsten alloy. This alloy in drawn wire form is intended for future use in springs subjected to elevated temperatures. For this reason it was decided to investigate both the tensile and the torsional fatigue properties of these wires at room and elevated temperature. This report covers the tensile room temperature properties; subsequent reports will deal with the torsional and the high temperature properties.

Experimental

Drawn wire 0.020 ins. diameter was cut on a diamond flexible wheel into 1 inch lengths. These lengths were gripped in conventional pin-chucks leaving a $^1/_4$" length of the wire subject to the fatigue loading (Fig. 1). These chucks were then mounted in a normal 2 ton Amsler Vibrophore machine. Despite the method of gripping all failures occurred in the gauge length, and none occurred at the gripping points.

The loads were applied in push pull about a mean zero and varied from ± 24 lbs to ± 64 lbs (i.e. ± 24.2 TSI - 91.2 TSI). With the $^1/_4$" gauge length it was found that the fatigue system was sufficiently rigid for the normal resonance of the machine. For the lowest loads it was found easier to apply the fatigue cycles by a Goodman electromagnetic vibrator mounted between the specimen and the dynamometer rather than through the load generating system of the Vibrophore. The Vibrophore load measuring unit was however employed. All tests were carried out at a frequency of 70 c/s.

Results

The fatigue results are presented in tabular form in Table 1 and graphically in Fig. 2. Within the range tested these show a linear reduction in fatigue life with increasing fatigue amplitude.

Discussion

The wire showed reproducible tensile fatigue properties without a great deal of scatter. The scatter did increase at lower loads, but at the very small loads accurate measurement of the applied load is quite difficult. The results show no unexpected features.

Table 1

Fatigue lives of 0.020 in. diameter wires in an iridium - 5% tangsten alloy subjected to push-pull loading.

Load		Cycles to Failure
± lbs.	± t.s.i.	
64	91.2	1.8×10^4; 1.9×10^4; 1.5×10^4
56	79.8	8.9×10^4; 9.7×10^4; 4.3×10^4; 4.0×10^4; 8.5×10^4
48	68.4	4.3×10^4; 5.4×10^4; 5.4×10^4; 1.2×10^5; 8.7×10^4
40	57.0	1.15×10^6; 2.3×10^5; 2.0×10^5; 5.0×10^5
36	51.3	3.3×10^5
32	45.6	1.6×10^6; 8.1×10^5; 2.7×10^5
24	34.2	1.2×10^7

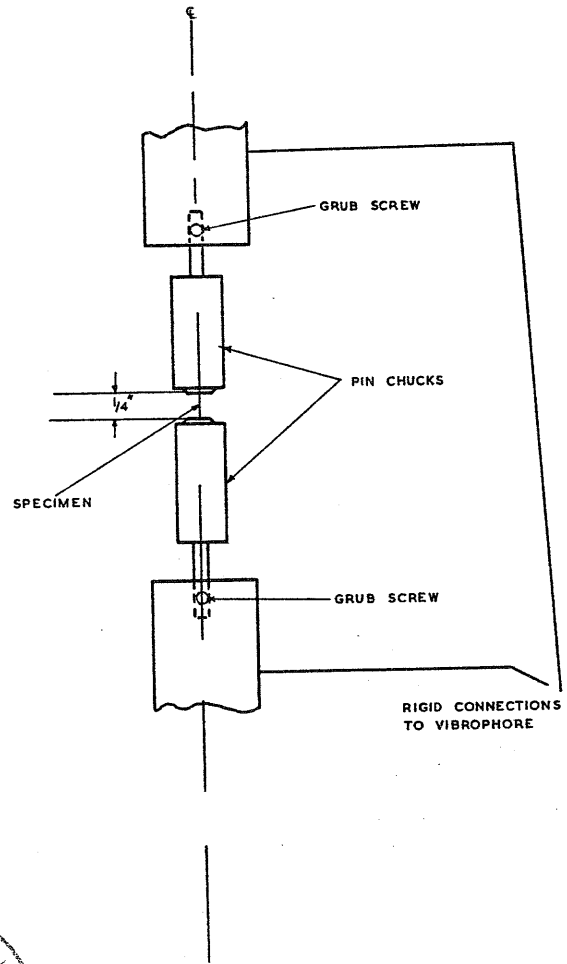

FIG.1. SPECIMEN GRIPPING ARRANGEMENT.

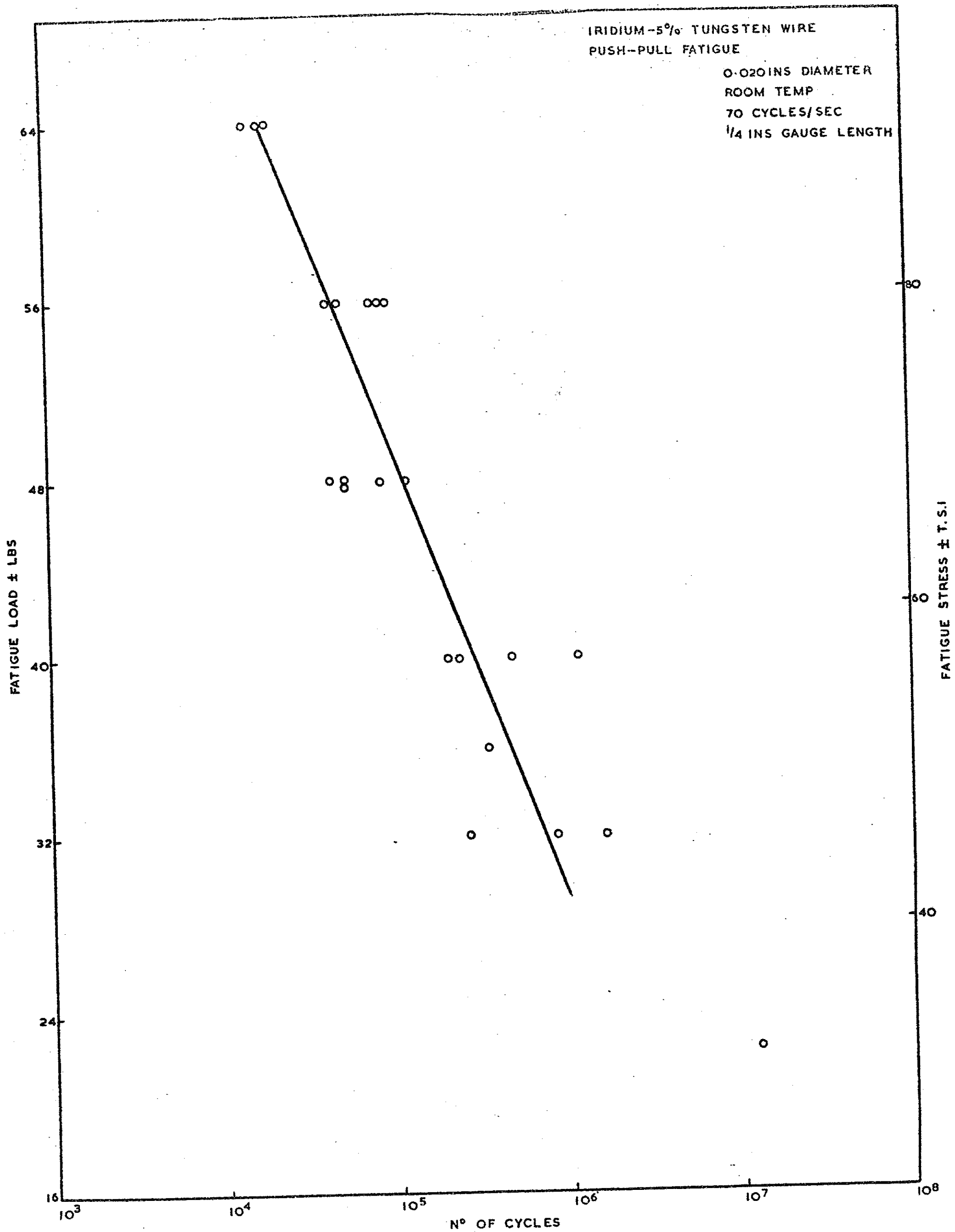

FIG.2. FATIGUE LOAD *vs* NO OF CYCLES TO FAILURE.