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NASA TECH BRIEF

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Erosion of Metals by Multiple Impacts with Water

Analytical and experimental investigations were conducted on the erosion of four metals by multiple impacts with water. The metals were: aluminum-1100-0; type-316 stainless steel; annealed commercially pure nickel; and an annealed titanium alloy, Ti-6Al-4V. Preliminary data were obtained for three turbine materials: Steelite-6B, Udimet-700, and molybdenum alloy TZM.

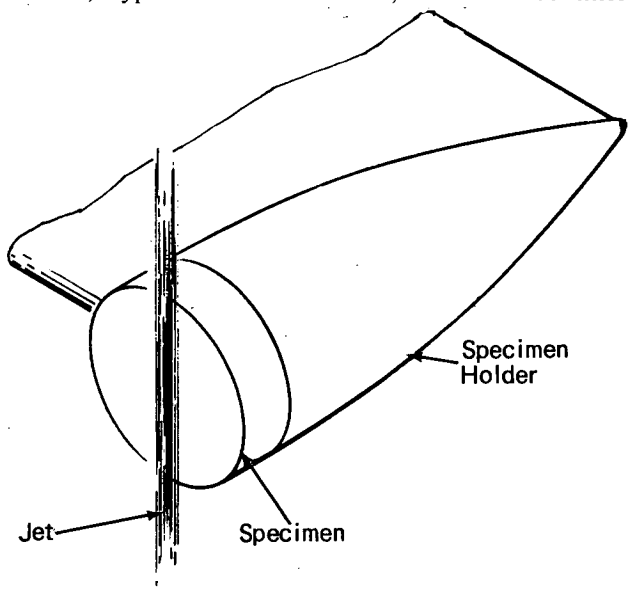

Figure 1. Impact of Water Jet by Test Specimen

Specimens mounted on a disk, rotating horizontally at speeds up to 20,000 rpm, cut vertical jets of tap water at 293K (68°F) twice per revolution (Fig. 1). The impact velocity is related to the minimum number of impacts causing visible indentation.

For the four metals, the fatigue strengths were experimentally determined as functions of the numbers of cycles to failure, using a high-frequency fatigue apparatus (Fig. 2). These data were correlated with the impact velocity data, in terms of the water-hammer pressure.

The erosion rates were determined as functions of the test durations at different velocities. These data were then compared with a recently developed theory of erosion. The fatigue-life distribution curves were also determined.

The specific objectives of the investigation were to: (1) determine the relation between impact velocity and the minimum number of impacts producing visible erosion; (2) determine the relation between high-frequency fatigue stresses and the number of cycles to failure; (3) determine the relation of water-hammer stresses (corresponding to impact velocities) to the high-frequency endurance limit; (4) determine the rate of erosion as a function of exposure time; (5) correlate the experimental data with a recent theory; (6) evaluate the erosion rate's dependence on the velocity of impact; and (7) compare the liquid-impact and cavitation-erosion strengths for the four metals.

Note:

The following documentation may be obtained from:

National Technical Information Service
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.95)

Reference:
NASA-CR-1288 (N69-19786), Experimental and Analytical Investigation on Multiple Liquid Impact Erosion

(continued overleaf)

Patent status:

No patent action is contemplated by NASA.

Source: A. Thiruvengadam and S. L. Rudy of Hydronautics, Inc. under contract to NASA Headquarters (HQN-10591)

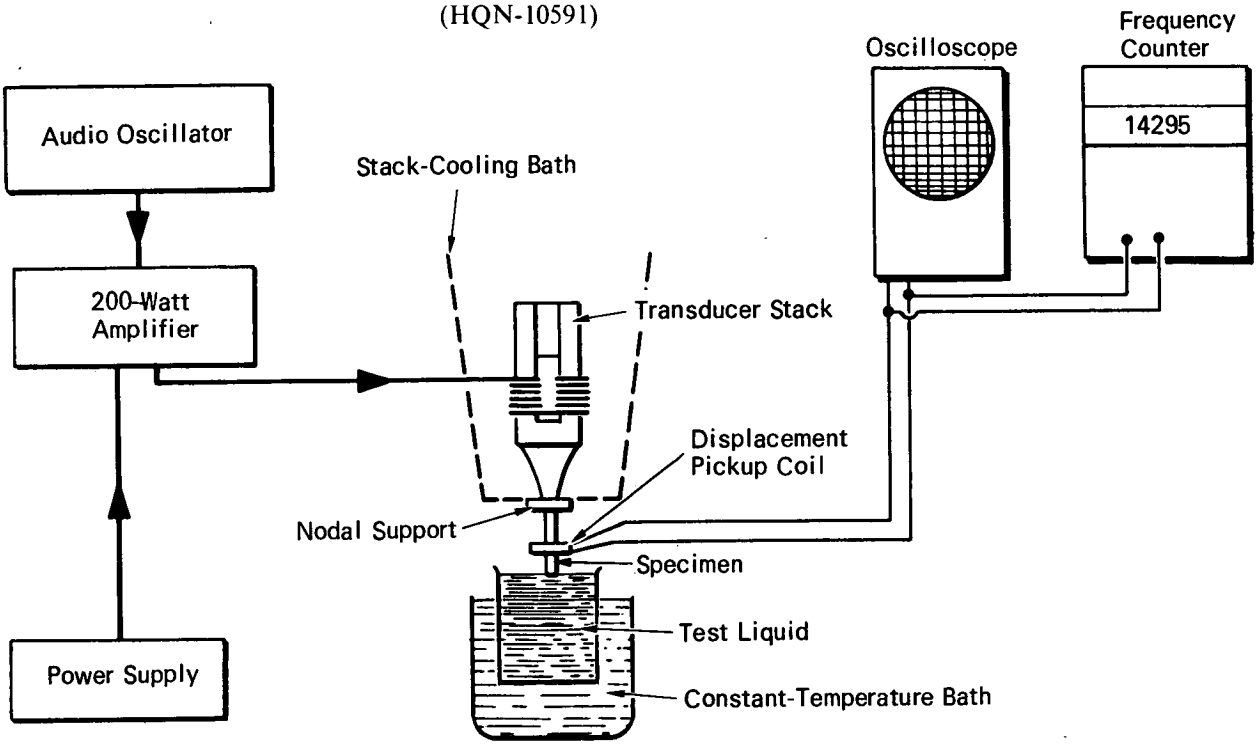

Figure 2. Block Diagram of the Magnetostriction Apparatus Used for High-Frequency Fatigue Tests