THE MEASUREMENT OF STRAIN DUE TO ALTERNATING STRESS

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Abstract

It has been shown that Hooke's law ceases to apply when the movements of a solid under stress are measured with sensitive apparatus. The stress-strain curve for a cycle of loading is a loop, of width about one-hundredth the maximum strain amplitude. Such a loop cannot be traced directly, as the width would not be visible on any scale which it would be practicable to plot. It is necessary to include in the apparatus a member of which the stress-strain curve is linear and is approximately the same slope as that of the specimen. The difference of strain abscissae gives the loop as a larger proportion of the total abscissa and can be amplified.

Apparatus was designed on this principle to plot the loop directly on the screen of a cathode-ray oscilloscope. The linear member was a proving ring slightly less than 4 ft. outside diameter, and specimens were rode about $\frac{1}{2}$ in. diameter. The two members were fixed together, and the ends were loaded intension. Low-loss movement gauges were fixed to each member and balanced in adjacent arms of a bridge, the output of which thus represented the non-linearity of the specimen. Loops were photographed as they formed on the screen, and the initial results of loss (from loop area) agreed broadly with published data. Experiments were done to see whether extraneous factors were affecting the observed loop. Finally, the trend of loss was found for compound loads made up of constant amplitude of alternating load and varying tensile direct load. It was found that in some circumstances the loops appear to saturate as does a magnetic hysteresis loop.