6. On the Method of Measuring the Young's Modulus of the Little Metal Specimens (Rods)

Kiichi Kimura, Akira Katase, Jun Kokame and *Yasuo Nawachi*

(K. Kimura Laboratory)

The natural frequency of the lateral vibration of the small rod was directly measured and the Young's modulus was calculated. The experimental method was as follows. A rod was suspended with two threads at its nodes of the free-free lateral vibration of the first order. Near one end of the rod, the driving coil (O.D. 1.42cm, length 2.5cm, 420 turns) was placed perpendicular to the rod axis in a horizontal plane. The driving current through the coil, of which frequency is variable, was about 500 ma. At the other end, a pick up coil was placed close to it, which was connected to the sensitive negative resistance oscillator as the L of its tank circuit. So the resonance of the rod causes the change in high frequency oscillating voltage of the oscillator. This was amplified and detected on the meter or the c.r.o.s. As for the sensitivity of the apparatus, it was sensitive for the amplitude of the vibration of the order of 10^{-3}mm, and the detectable shortest sample was about 3 cm in length, 0.3 cm in diameter.

The calculation of the Young's modulus was performed solving the differential equation containing shearing effect (cf. Timoshenko: Vibrational Problems in Engineering, New York, 1928, p. 227 and p. 231). The samples used were thirteen pieces of iron rod (spring wire), 3 mm in diameter, 11 to 3 cm in length. The Young's moduluses calculated from the observed resonance frequency were not the same value for each sample. (For example, see Table 1.) More minute investigation is in progress.

l cm	f cycles/sec	$E\times10^{11}$dyne/cm^2
$10.0377\pm2.7\times10^{-3}$	1376.5 ± 5.8	21.075
$8.0533\pm1.6\times10^{-3}$	2128.1 ± 1.4	20.933
$5.7663\pm1.6\times10^{-3}$	4125.9 ± 1.4	20.842
$3.2033\pm2.1\times10^{-3}$	13315.6 ± 0.4	21.402

Table 1.