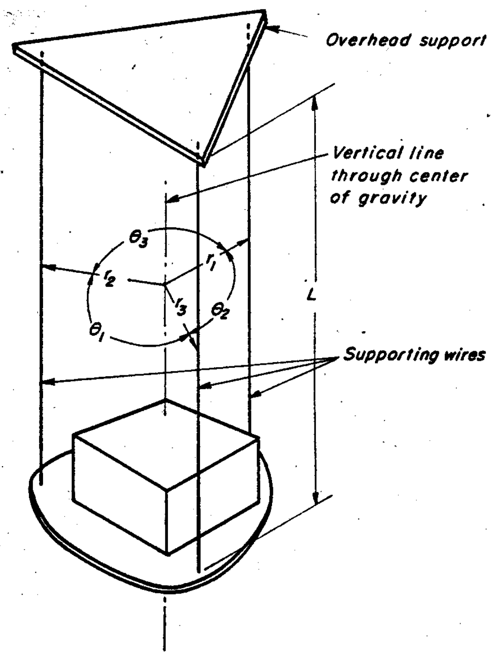

Determining Moment of Inertia

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IT frequently is necessary to know the moment of inertia, or radius of gyration, of a machine or machine part. This information is needed to determine types and locations of vibration mounts, to calculate critical frequencies of machine elements, and for other purposes. An accurate method is to suspend the part in such a manner that it may vibrate torsionally, and measure the period of free vibration.

Technique used at The Barry Corporation is illustrated in the accompanying figure. A plywood platform, essentially triangular in outline, is suspended from an overhead support by means of three equally spaced parallel wires. The body whose moment of inertia is to be determined is set on the platform, preferably with its center of gravity directly above the geometrical center of the platform. It is essential that the axis about which the moment of inertia is to be determined be vertical. This is easily arranged by inserting blocks of proper height between the body and the platform. The platform is then caused to vibrate torsionally with small amplitude about a vertical axis and the period of free vibration measured by a stop-watch or other means.

CALCULATIONS: For the general case, in which a vertical line through the center of gravity of the combined body and platform does not pass through a point equidistant from the three supporting wires, the equation for determining the moment of inertia is

$$I = \frac{W r_1 r_2 r_3 T^2}{4\pi^2 L}\left[\frac{r_1 \sin\theta_1 + r_2 \sin\theta_2 + r_3 \sin\theta_3}{r_2 r_3 \sin\theta_1 + r_1 r_3 \sin\theta_2 + r_1 r_2 \sin\theta_3}\right] \quad (1)$$

where W = weight of combined body and platform, lb; T = period of oscillation, sec; L = length of supporting wires, in.; r = distance from center of gravity to supporting wire, in.; θ = angle between radial lines from center of gravity to supporting wires; and I = moment of inertia of combined body and platform, lb in. sec.^{2}

If the body can be set on the platform in such a manner that its center of gravity lies directly above the geometrical center of the platform, Equation 1 is greatly simplified, as all distances r become equal and all angles θ become equal to 120 degrees. The simplified equation is

$$I = \frac{W r^2 T^2}{4\pi^2 L} \quad (2)$$

Values of r and L in Equation 2 are constant for any given installation. In the installation at The Barry Corporation, for example, r = 10 inches and L = 55 inches. Equation 2 is then further simplified as follows:

$$I = 0.0461\ W T^2 \quad (3)$$

It has been determined that the platform alone weighs 3½ lb and that its moment of inertia is 0.456 lb in. sec.^{2} The moment of inertia of any body may then be found conveniently by adding 3½ lb to its weight, determining the combined moment of inertia from Equation 3, and subtracting 0.456 from the combined moment of inertia to obtain the net moment of inertia of the body.