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A PRACTICAL METHOD FOR DRAWING CALIBRATION CURVES

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A certain inconvenience is involved in the routine construction of calibration curves for a large station network. This is especially true with a calibration method involving the use of a sinusoidal force produced with a coil and a permanent magnet. (TEIKARI [1]). Therefore a simple tool has been developed for plotting the curves graphically.

Let us consider the system magnification of a seismometer.

$$M = \frac{X \cdot m \cdot w^2}{F}$$

where

M = system magnification
X = trace amplitude of o-peak [cm]
m = seismometer mass [g]
$w = \frac{2\,\widetilde{II}}{T}$ = angular velocity [1/s]
$F = k \cdot I$ = sinusoidal force [dyne]
k = constant of the calibration device [dyne/mA]

This can be written

$$\text{Log } M = \text{Log } X + \text{Log } \frac{m}{F} + \text{Log } w^2$$

The lines for Log X and Log w^2 are drawn on a transparent template, while the line for Log $\frac{m}{F}$, which is a constant, is drawn on

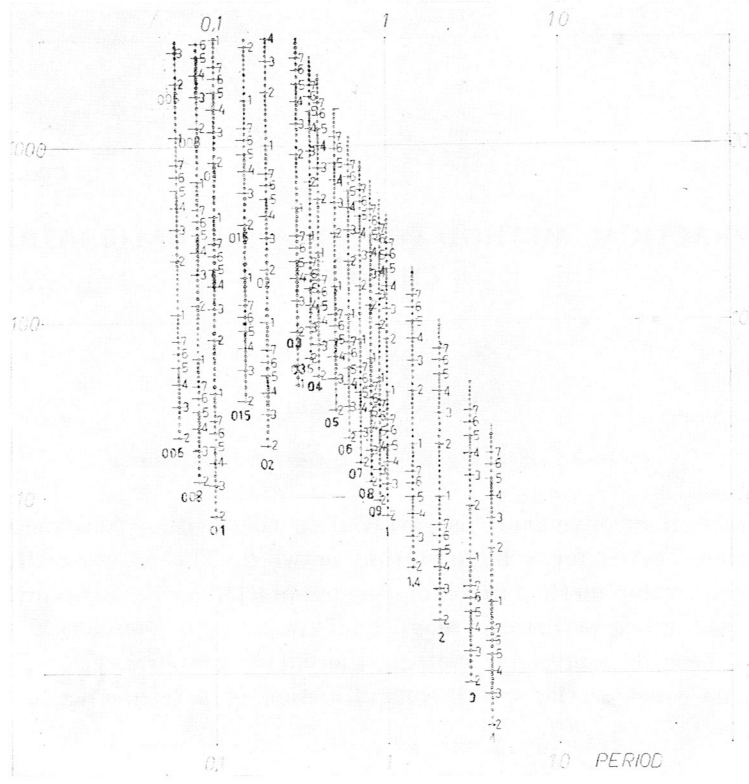

Fig. 1. A tool for graphic construction of calibration curves.

bilogarithmic paper on the same scale. The template is shown in fig. 1.

To produce the magnification, the template is placed on bilogarithmic paper so that the line for logarithmic unity coincides with that of Log $\frac{m}{F}$ drawn on the paper.

This is illustrated by an example as follows (refer to fig. 2):

$$\begin{aligned} T &= 1\text{s} \\ m &= 4260\ \text{g} \\ k &= 19.6\ \text{dyne/mA} \\ I &= 2\ \text{mA} \\ X &= 3.40\ \text{cm} \\ F &= 39.2\ \text{dyne} \\ \frac{m}{F} &= \frac{4260\ \text{g}}{39.2\ \text{dyne}} = 109\ \text{g/dyne} \end{aligned}$$

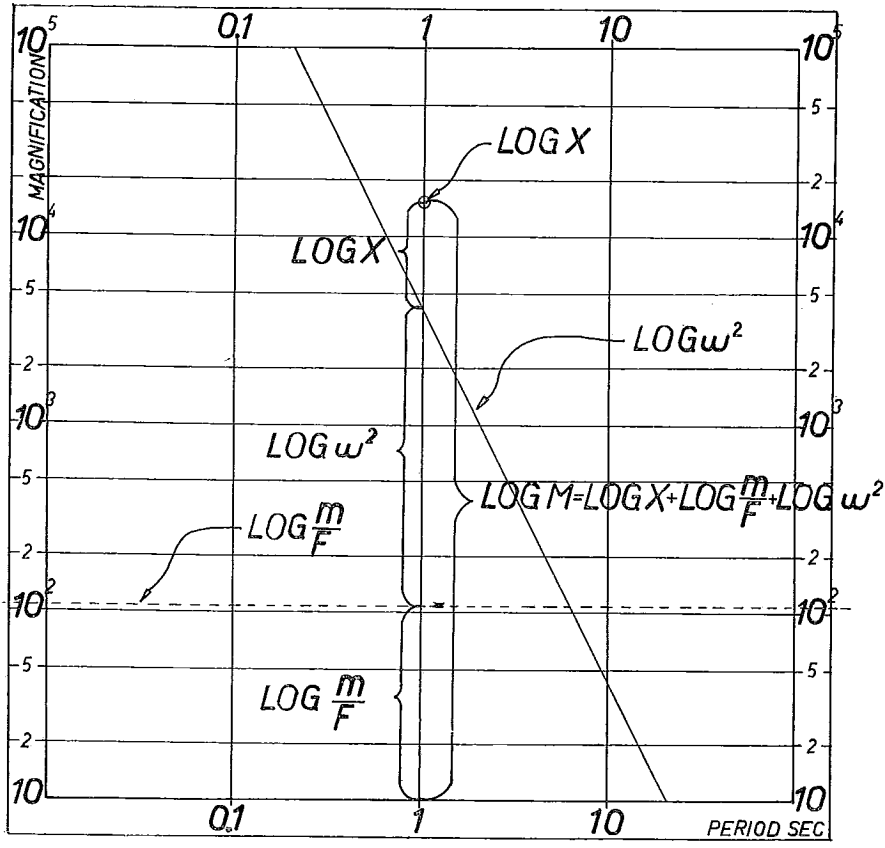

Fig. 2. Plotting of the calibration points.

When the amplitude value 3.40 cm is plotted through the hole in the template, the system magnification will be M = 15000. The whole curve is constructed by repeating the procedure for different T-values. The accuracy obtainable with this template is approximately 2%, which is somewhat less than could be achieved by drawing the curve in the usual manner.

This has not much signifiance, however, because the method itself suffers from the total relative error, which is always larger.

The total relative error of the calibration system is

$$\frac{\triangle M}{M} = \frac{\triangle X}{X} + \frac{\triangle m}{m} + \frac{2\triangle w}{w} + \frac{\triangle k}{k} + \frac{\triangle I}{I}$$

$$= (0.7\%-5\%) + 0.2\% + 4\% + 0.5\% + 0.8\% = 6.2\% - 10.5\%$$

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