Hysteresis

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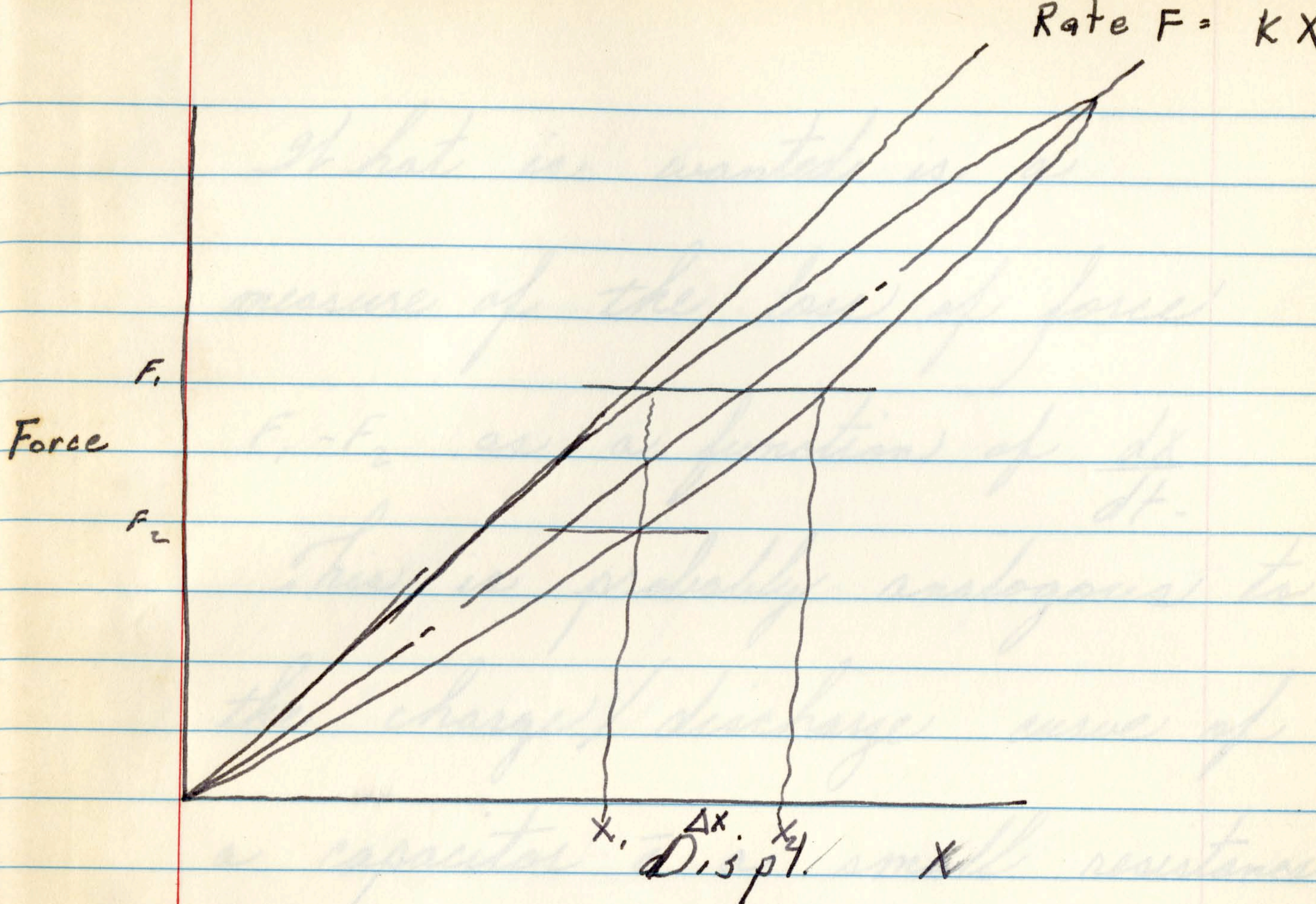
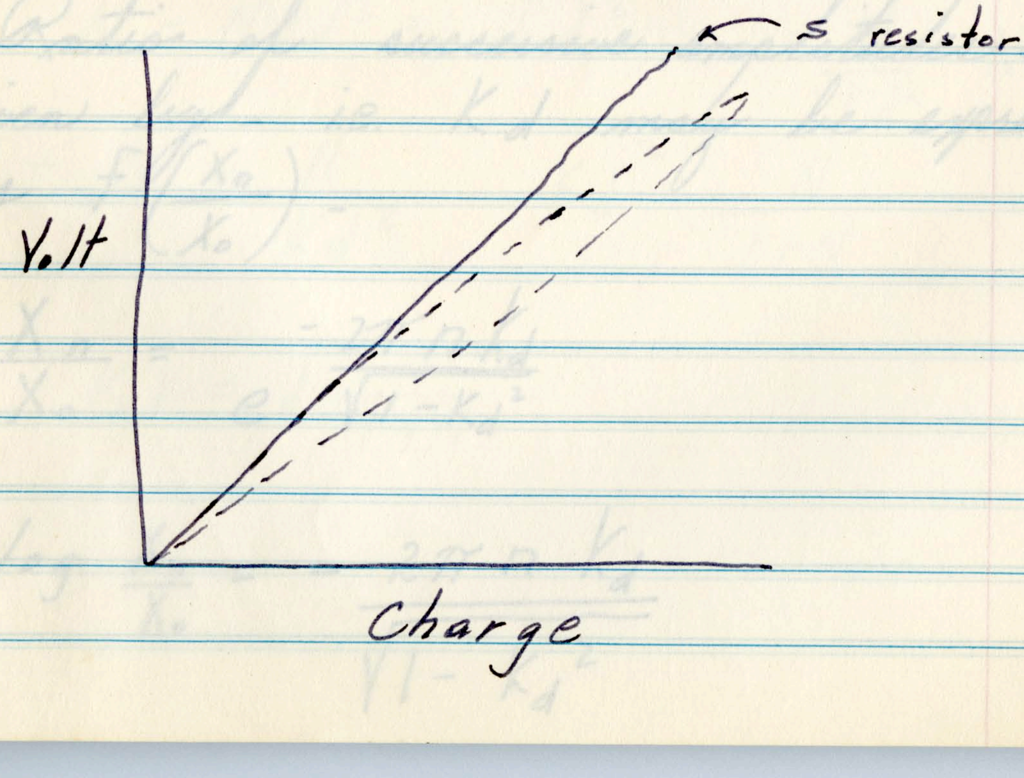


$$\text{Hysteresis} = \frac{\Delta X}{X}$$

Could find little or nothing in the literature or in discussion $\bar{c}$ Mr. Gebore of Chatillon on the shape of the above curve.

What is wanted is a measure of the loss of force $F_1 - F_2$ as a function of $\frac{dx}{dt}$.

This is probably analogous to the charge/discharge curve of a capacitor $\bar{c}$ a small resistance in series.



Rather than to attempt the solution from static curves which could at best be measured $\bar{c}$ difficulty, a dynamic experiment will be attempted.

$$K_d = \frac{R}{2\sqrt{KM}} \quad \& \quad R = K_d\, 2\sqrt{KM}$$

Ratio of successive amplitudes is given by - i.e. K_d may be expressed as $f\left(\frac{X_n}{X_0}\right)$ -

$$\frac{X_n}{X_0} = e^{-\frac{2\pi n K_d}{\sqrt{1-K_d^2}}}$$

$$\log \frac{X_n}{X_0} = -\frac{2\pi n K_d}{\sqrt{1-K_d^2}}$$

$$M$$

$$\alpha \left(\log \frac{X_o}{X_n} \right) = \frac{2\pi \; n k_d}{\sqrt{1 - k_d^2}}$$

$$M^2 = \frac{4\pi^2 n^2 K_d^2}{1 - K_d^2}$$

$$N$$

$$\left(\frac{M^2}{4\pi^2 n^2} \right) = \frac{K_d^2}{1 - K_d^2} = \frac{\left(\log \frac{X_o}{X_n} \right)^2}{4\pi^2 n^2}$$

$$N = \frac{Kd^2}{1 - Kd^2}$$

$$N - NKd^2 = Kd^2 \qquad 1 = \frac{N}{Kd^2} - N$$

$$1 + N = \frac{N}{Kd^2} \qquad Kd^2 = \frac{N}{1 + N}$$

$$K_d = \sqrt{\frac{N}{1 + N}}$$

$$K_d = \sqrt{\dfrac{\dfrac{\left(\log \frac{X_0}{X_n}\right)^2}{4\pi^2 n^2}}{1 + \dfrac{\left(\log \frac{X_0}{X_n}\right)^2}{4\pi^2 n^2}}}$$

By taking half amplitudes

$$X_n = \frac{X_0}{2}$$

$$\log 2 = .3 \qquad (.3)^2 = .09$$

Take as example $n = 200$

$$K_{d_{200}} = \sqrt{\dfrac{\left(\dfrac{9 \times 10^{-2}}{12.56 \cdot 4 \times 10^4}\right)}{1 +}} = \frac{9 \times 10^{-2}}{50.24 \times 10^4} = .18 \times 10^{6}$$

$$\approx \sqrt{18.} \times \sqrt{10^{-8}}$$

$$\approx 4 \times 10^{-4}$$

A simpler approximation
for $K_d < .1$ is

$$\frac{X_1 - X_2}{X_1} \simeq 2\pi K d$$