

ON A SEISMOGRAPH FOR LARGE MOTIONS

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The problem, which has for the most part occupied attention in this country, has been the registration of small motions and, for experimental purposes, these are perhaps the most convenient of all motions. According to the old ideas regarding Seismometers it ought not to be a difficult problem to design an instrument for large motion, as a long pendulum made to write directly or made to give a *diminished* record of two components is exactly the thing required. We find it difficult however to prevent a pendulum swinging to such an extent during a large earthquake that the record can hardly be interpreted. I have no doubt however but that some modification of the pendulum instrument will be found the best instrument.

The instrument to which I wish to direct attention may be called such a modification; it consists of a hollow metallic cylinder resting on a flat smooth level plate. Such an instrument can be made perfectly astatic or it can have any degree of stability required by loading one side or by controlling its motion by means of a spring. The axis of spontaneous rotation for such a cylinder when its lower side is moved in a direction at right angles to its axis is very nearly at the highest point of the inner surface of the cylinder if the cylinder be moderately thin. If t be the thickness of the cylinder, r_1 and r_2 the internal and external radii, then h the height of the spontaneous axis is,

$$h = \frac{k^2 + r_2^2}{r_2} \text{ when } k^2 = \frac{r_1^2 + r_2^2}{2}$$

$$\therefore h = \frac{r_1^2 + 3 r_2^2}{2 r_2} = 2 r_2 - \frac{r_2 t - \frac{1}{2} t^2}{r_2}$$

when t is small this is approximately $= r_2 + r_1$.

For giving stability to this arrangement I am inclined to think that a small cylinder placed inside the large one will prove good. Perhaps the best way will be, to control the cylinder by means of a light frame, pivotted at the ends of the axis of the cylinder and suspended from a point above, so that it can swing like a pendulum. The ends of the axis of the cylinder may be made to act in slots, or a light spring may be introduced into the suspension so as to give flexibility.

In registering a large earthquake, the most convenient arrangement is to fix a flexible spring and sharp point in such a way, that the point is in the axis of the cylinder produced. This point will move backwards and forwards in a straight line and may be caused to record on a moving vertical plate.

It is of course evident that this arrangement may be used for small motions by simply adding multiplying levers.

This arrangement also offers facilities for the addition of a weight, which may be put on the top of the two cylinders; grooves being cut out in the cylinders to allow it to be placed at the theoretically steady point. Radically with a thin cylinder grooves will not be needed because the actual steady axis is always a little above the theoretical axis.

Two degrees of freedom are of course obtained by mounting the cylinders on a platform, placed on the top of two cylinders with their axes at right angles to that of the top cylinder.