

DI Physics Jems.

Paper-I

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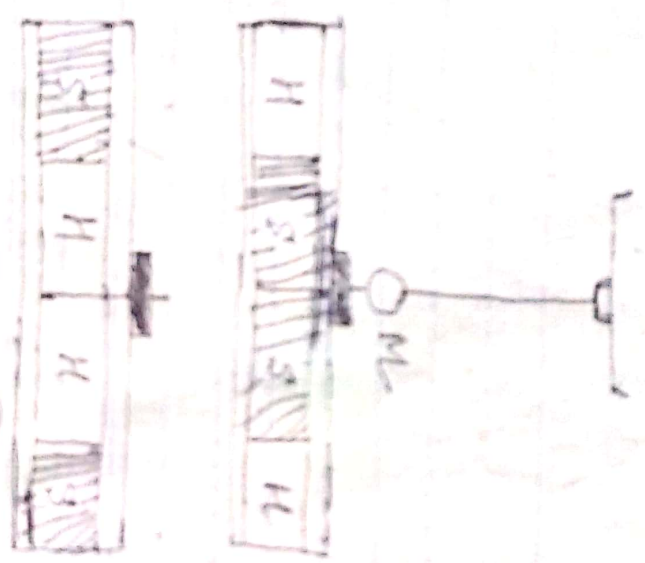


Fig. (1)

The method, using Maxwell's method for the determination of modulus of rigidity of the material of a wire is a dynamical method. Maxwell's method consists of a long hollow brass tube of length L , supported horizontally by a vertical wire, whose modulus of rigidity is to be determined. The M end of the wire is clamped to a rigid support.

Four brass cylinders, two hollow and two solid, of identical lengths and diameters, can be fitted inside the hollow brass tube. The length of each cylinder is $\frac{1}{4}$ and when they are placed in end to end, they just fill the hollow tube completely. To facilitate the pointing of vibrations of the Maxwell needle, a small plane mirror is attached to the specimen vice and observations are taken with the help of telescope and scale arrangement.

Theory and Method:

First, the solid cylinders

S, S are placed in the inner positions and the hollow cylinders H, H in the outer positions as shown in Fig. ①. The system is allowed to perform torsional oscillations, let T_1 be the time period of vibration then

$$T_1 = 2\pi a \sqrt{I/c} \quad \text{--- (1)}$$

where I_1 is the moment of inertia of the suspended system about the wire as axis and C the torsional couple per unit twist of the wire.

Next, the positions of the hollow and solid cylinders are interchanged. Now, if T_2 be the moment of inertia of the system about the wire as axis, then the time period, is given by

$$T_2 = 2\pi a \sqrt{I_2/C} \quad \dots \quad (ii)$$

From eqns. (i) and (ii), we get

$$C = \frac{4\pi^2 a (I_2 - I_1)}{T_2^2 - T_1^2}$$

But $C = \frac{n\pi r^4}{2l}$,

where l and r are the length and radius of the specimen wire respectively.

$$\frac{n\pi r^4}{2l} = \frac{4\pi^2 a (I_2 - I_1)}{T_2^2 - T_1^2}$$



न बिल्ट साइड स्टैंड
जन कट-आफ़ स्विच
सुविधाजनक और खयाल र
यह सुनिश्चित करे कि साइड-स्टैंड व
स्टार्ट न हो। साइड स्टैंड लगा होने प
यह सुनिश्चित करने का एक सुविधा

or $n = \frac{2 \pi R (I_2 - I_1)}{(I_2^2 - I_1^2)} \dots (iii)$

Let I_0, I' and I'' be the moments of inertia of the hollow brass case, solid and hollow cylinders respectively about the axis passing through their centres. If gravity and perpendicular to their lengths. As the length of each cylinder is $\frac{3L}{4}$, moment of inertia of the needle I_0 about the axis placed near the hollow cylinders are placed near the ends of the hollow brass tube, is given by

$$I_0 = I_0 + 2 \left[I' + m_1 \left(\frac{L}{4} \right)^2 + 2 I'' + m_2 \left(\frac{3L}{4} \right)^2 \right]$$

$$I_1 = I_0 + 2 I' + 2 I'' + 2 m_1 \left(\frac{L}{8} \right)^2 + 2 m_2 \left(\frac{3L}{8} \right)^2$$

where m_1 is the mass of each solid cylinder and m_2 that for each hollow part. Similarly, moment of inertia of the system I_2 , when the solid cylinders are at ends, about the same axis is

$$I_2 = I_0 + 2 I' + 2 I'' + 2 m_1 \left(\frac{3L}{8} \right)^2 + 2 m_2 \left(\frac{L}{8} \right)^2$$

एक्सलरेशन क्लर

लाइट व्हेट इंजन आपको दे शक्तिशाली प्रदर्शन के साथ एक आरामदायक राइड।

- Blue Bikes | Gurgaon | Angel Automobiles - 8002708020 | 8734351144 | Yamaha Bike Stallion | Patna | Sri Sai Yamaha - 8051865511, 6051482274, 7061222201
- 9534760033 | Arrah | Singh Automobiles - 9334495001, 8292502881 | Authorized Dealers | Bihar | Shanti Nalanda Auto Condocto
- Automotive - 6799301671 | 9521777700 | Sineha Automobiles - 8835016689 | Chhapra
- Enterprises - 9631024640 | Dighe Sun Motors - 9134447241 | 7319054463 | Faiz
- Enterprises - 7782875350 | 8982712599 | Buzar Pooja Motor - 9905310658 | Shahi
- Lalganj | New Vatsahi Auto Agency - 9431461655, Hitesh Motor Automobile - 9701302718 | Dohri | A.H. Sharma Associates - 9771337382, Bikramganj | Janki Automobiles - 7250333000, 9525574039 | Kaimur | Maa Mundeshwari - 7033955396, 8685900800
- 9180942697, 9504123682 | Arwal | Anil Enterprises - 9710621150 | Lakhisarai | Sai Automobiles - 9108051577, Barh | Hemant Motors - 8540773934, Aditi Yamaha - 7004973390, Maslaha | Natraj Motors - 9211534041 | Pakribarawan | Nexgen Motors - 83404

Substituting eqn. (iv) from (v) & (vi) we get

$$-I_1 + I_2 = (m_1 - m_2) \frac{g}{4} \quad \text{--- (vi)}$$

Substituting the value of $(I_2 - I_1)$

from eqn. (vi) in eqn. (iii), we have

$$n = \frac{2\pi (m_1 - m_2) L_0^2 L}{(T_2^2 - T_1^2) g} \quad \text{--- (vii)}$$

The time period T_1 and T_2 in

the two cases are calculated with the help of telescope and scale arrangement.

The length of the tube L_0 and length of the wire L are measured by a

metre scale. Masses of the cylinders, m_1 and m_2 , are obtained by weighing.

The radius of the wire r is measured with the help of a screw gauge

at several places on the wire in two perpendicular directions and its

mean value is calculated and its

substituting the values of m_1 , m_2 , r , L_0 , L , T_1 , T_2 , g in (vii), we

can calculate the modulus of rigidity of the material of wire. Maxwell's needle

has the following two advantages over torsional pendulum:

i) In Maxwell's needle, the load suspended at the end of the wire remains the same since only the positions of solid and hollow cylinders are interchanged. Thus, the couple C is not varied due to torsional reaction remaining constant.

ii) Here, the calculation of $(T_1 - T_2)$ reduces to the determination of the difference between the masses of solid and hollow cylinders and the length of the hollow tube can be measured accurately and easily.