DI Physics Hons.

Paper-I

Dr. Sanjeet Kumar
Assistant Professor
Deptt. of Physics
M.D. Jain College, VKSU,
Ara, Bihar-802301, India.

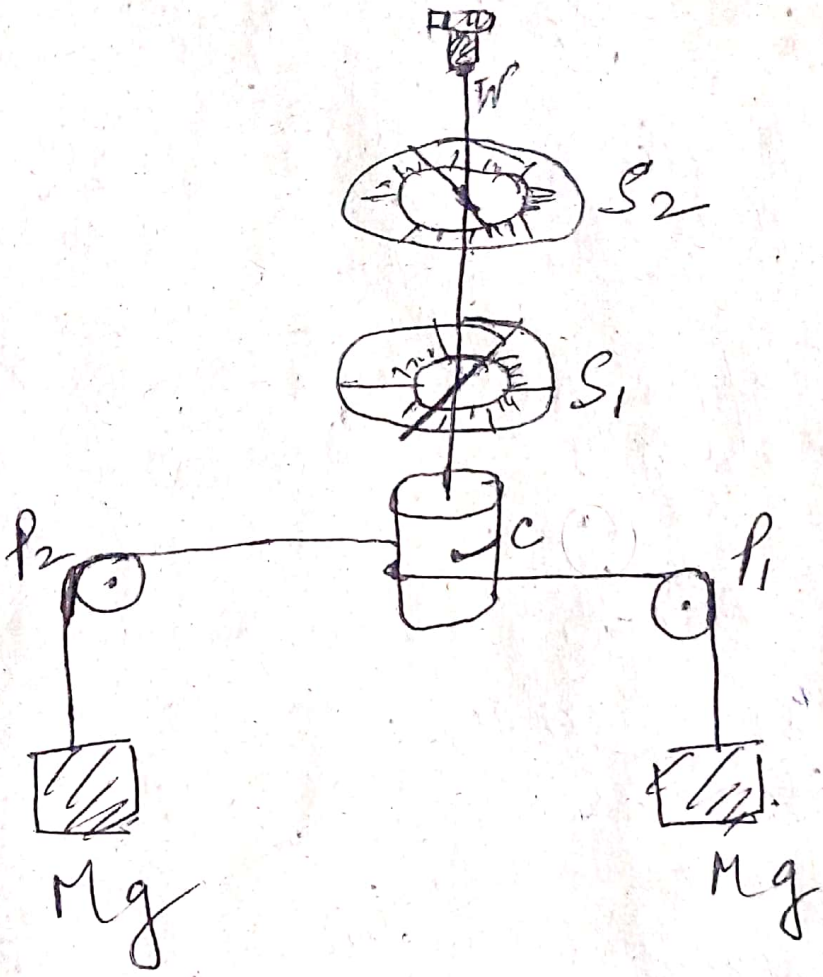


Fig (3).

For the determination of modulus of rigidity of the material of a wire the apparatus due to Barton is shown in Fig. (3).

The wire W, whose modulus of rigidity is to be determined, is clamped at its upper end to a rigid support and carries a heavy cylinder C at its lower end.

such that they [illegible] the cylinder tangentially and leave the cylinder ~~leave~~ pass over two frictionless pulleys P_1 and P_2 as shown in fig (3). The free ends of these cords carry equal weights.

Two pointers fixed two wire, separated by a known distance move respectively over the circular scales S_1 and S_2 graduated in degrees. Levelling screws are also provided at the base of the apparatus so as to make the arrangement horizontal.

Theory and Method:

If M be the mass suspended from each of the cord and D be the diameter of the cylinder, then the moment of the couple twisting the wire is

$$= Mg.D$$

This couple twists the wire and the angle of twist for the length l of the wire between the two pointers is measured by the difference of twists as recorded on two circular scales S_1 and S_2. Let it be $\theta = \theta_2 - \theta_1$, where θ_1 and θ_2 are the twists in radians measured on the two circular scales S_1 and S_2 respectively.

The twisting couple is balanced by a restoring couple, set up in the wire which is equal to $n\pi r^4\theta/2l$, where r is the radius of the wire.

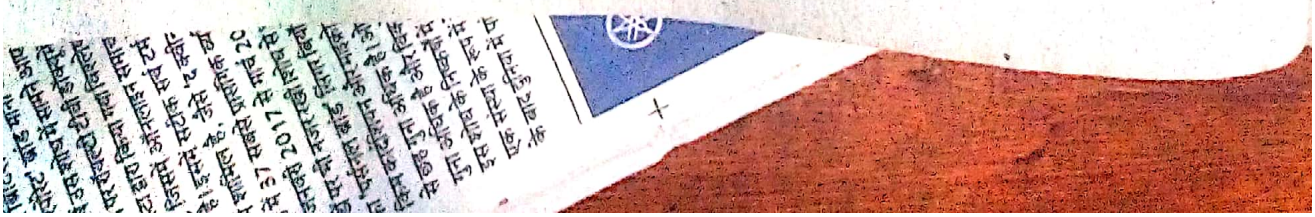
$$\therefore \frac{n\pi r^4}{2l}.\theta = Mg.D$$

If θ_1 and θ_2 have been measured in degrees, then

$$\frac{n\pi r^4}{2l}.\theta.\frac{\pi}{180} = Mg.D \quad \left[\because \theta^\circ = \theta.\frac{\pi}{180} \text{ radian}\right]$$

$$\therefore n = \frac{360\, Mg.Dl}{\pi^2 r^4 \theta}$$

The length l of the wire between the two pointers is measured by a



meter scale. The radius r of the wire is measured by a screw gauge at several points and mean is taken. The diameter (d) of the cylinder is measured by a Vernier callipers. Hence, by substituting the values of various quantities in the right hand side of the above expression, n for the material of the wire is calculated.

The two sources of errors in the previous method are eliminated here:

(i) On account of the use of double-end pointers, this apparatus is free from any errors due to the eccentricity of the wire with respect to the circular scale.

(ii) By using the two pulleys, there is no side pull on the wire