Measurement of Torque (Torsion meters)

INTRODUCTION OF TORQUE

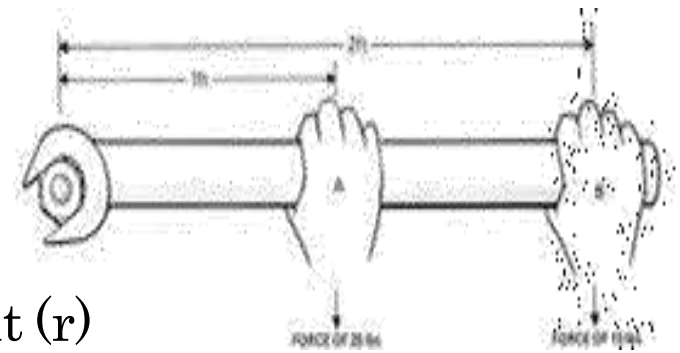
- Torque is defined as a twisting force that tends to cause rotation.
- Torque is by definition a quantity that represents the tendency of a force to rotate an object about an axis.
- Unit. Nm
- E.g. the force generated by an internal-combustion engine to turn a vehicle's drive or shaft.

- The torque may be computed by measuring the force F at a known radius r.

$$T = Fr$$

where, F = force (N)

r = radius from pivot point (r)



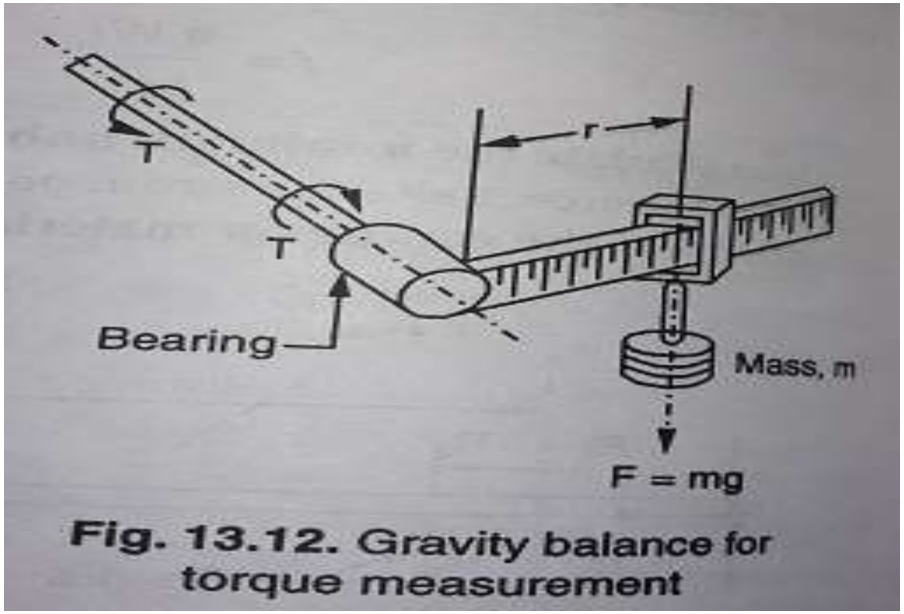


Fig. 13.12. Gravity balance for torque measurement

- Known mass (m) is moved along the arm so that the value of torque (F x r) equals the torque (T) which is to be measured.
- Alternatively, magnitude of the mass may be varied, keeping the distance r constant.

$$r \propto T \text{ (m and g are constant)}$$

$$m \propto T \text{ (r and g are constant)}$$

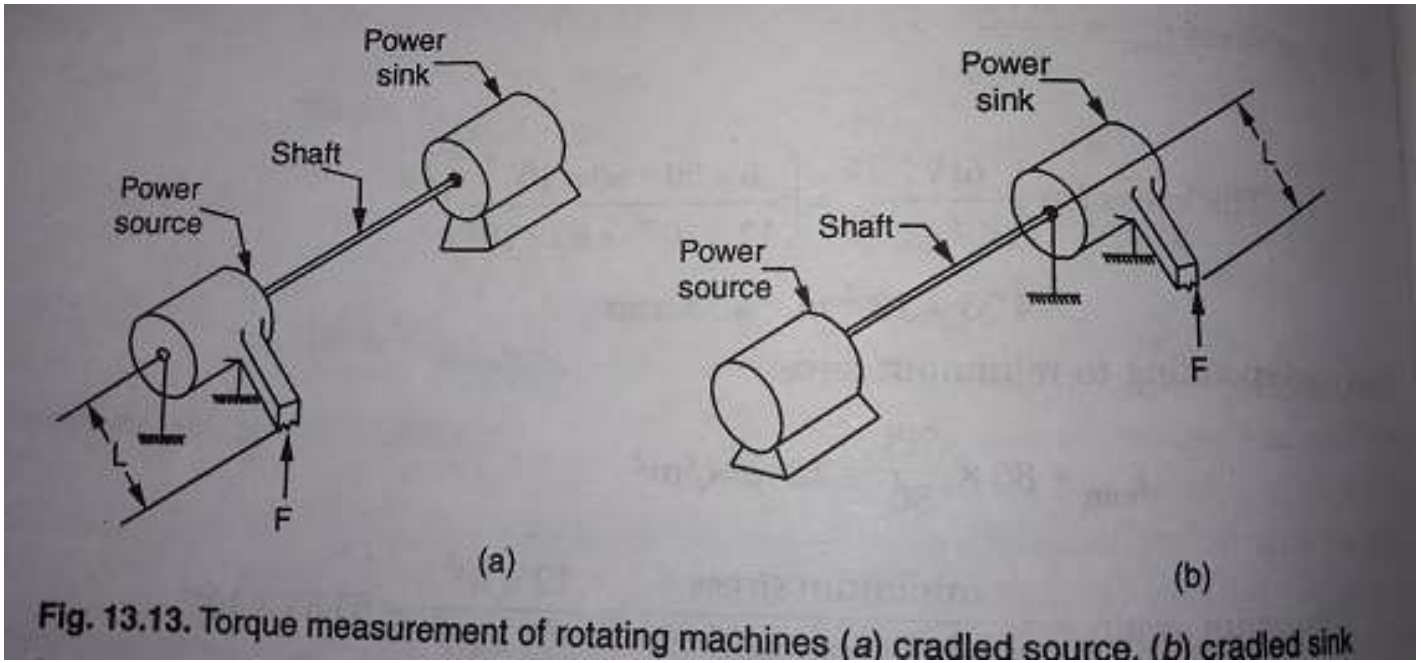


Fig. 13.13. Torque measurement of rotating machines (*a*) cradled source, (*b*) cradled sink

- It involves a power source, power transmitter (shaft) and a power sink(also called as power absorber or dissipator).
- This concept of bearing mounting is called ***cradling*** and this forms the basis of most shaft power dynamometers.

$$\frac{T}{I_p} = \frac{f_s}{r} = \frac{C\theta}{l}$$

- Shaft-twisting relation gives:

$$T = \left(\frac{I_p}{l} \right) x f_s \quad ; \quad \text{T = constant x fs}$$

$$T = \left(\frac{I_p C}{l} \right) x \theta ; \quad \text{T = constant x } \theta$$

1. Mechanical Torsion Meter

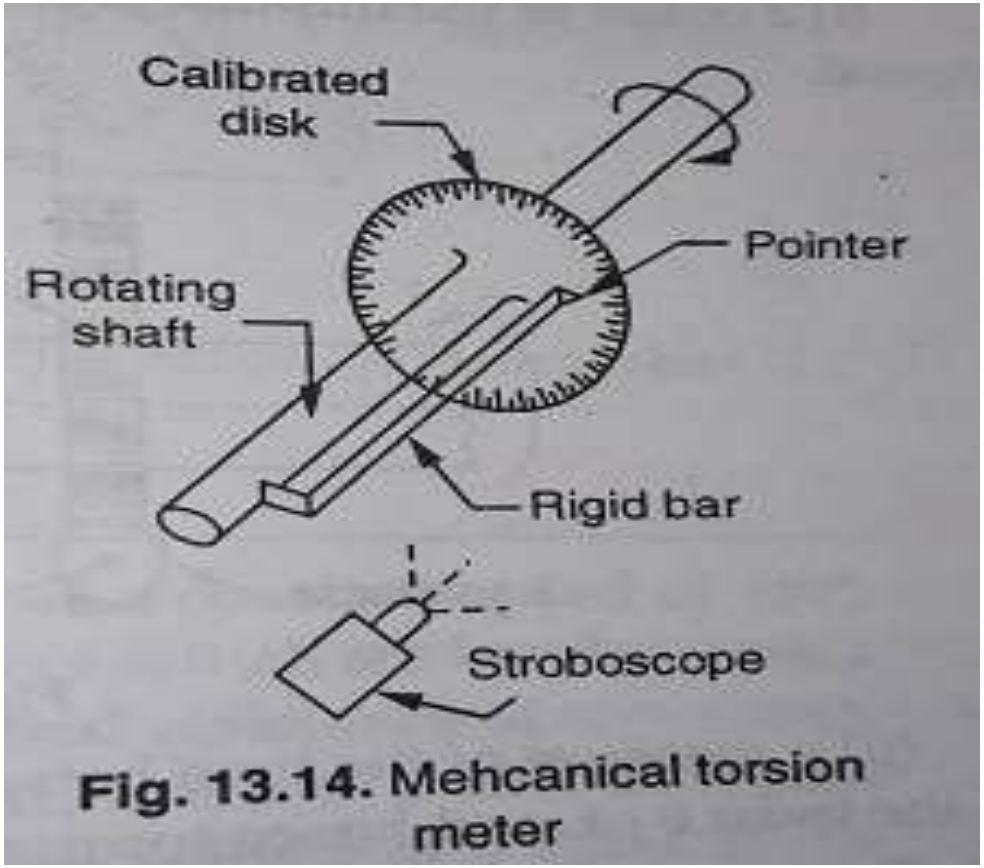


Fig. 13.14. Mehcanical torsion meter

2. Optical torsion meter

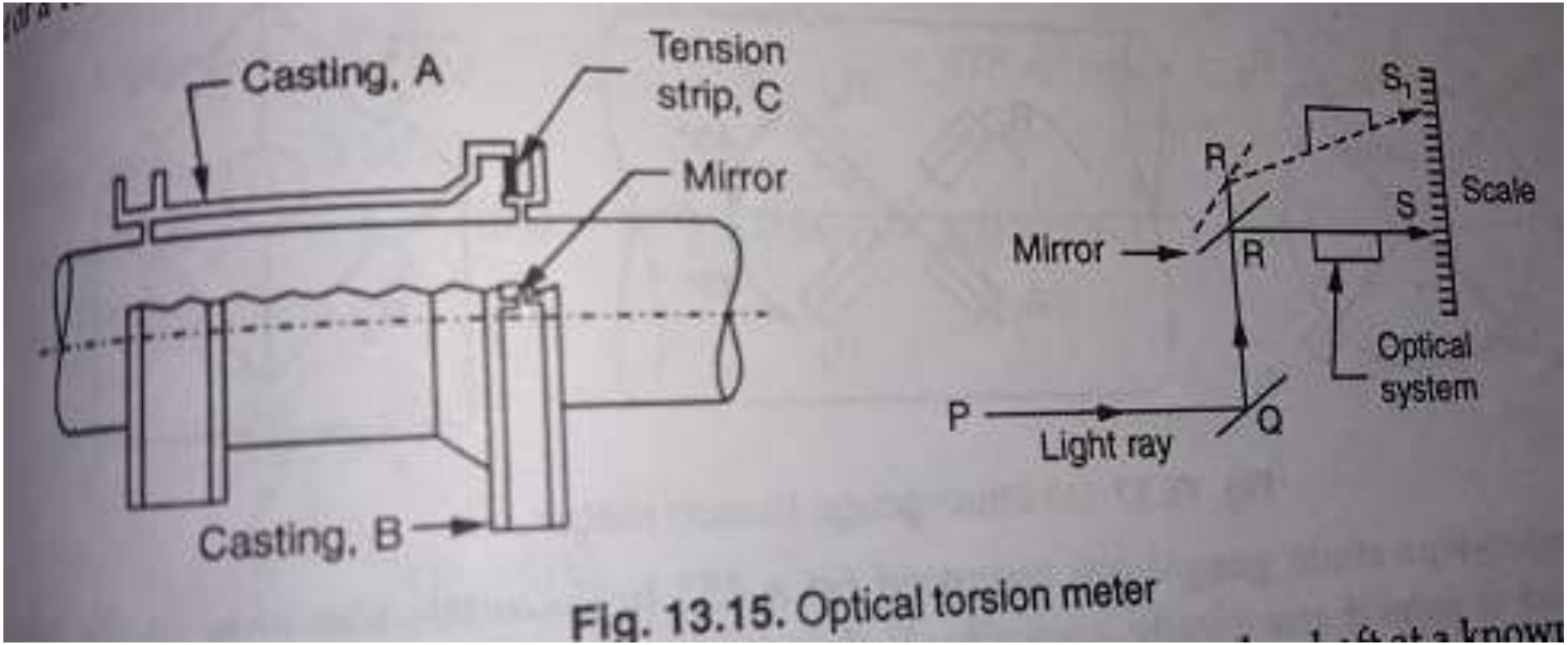


Fig. 13.15. Optical torsion meter

3. Electrical torsion meter

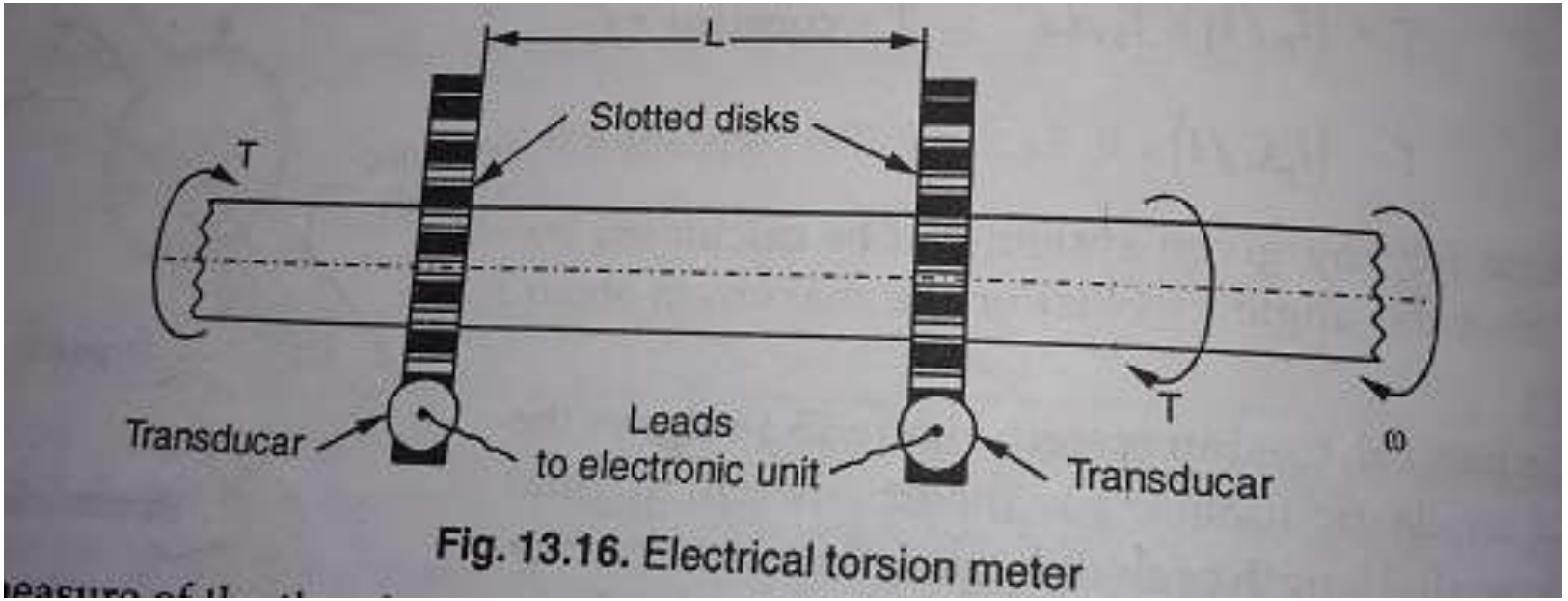


Fig. 13.16. Electrical torsion meter

- Involves two sets of measurement:

1. A count of the impulse from either slotted wheel. This count gives the frequency or shaft speed.
2. A measure of the time between pulses from the two wheels. This signal is proportional to the twist θ of, and hence torque T in the shaft.

4. Strain-gauge torsion meter

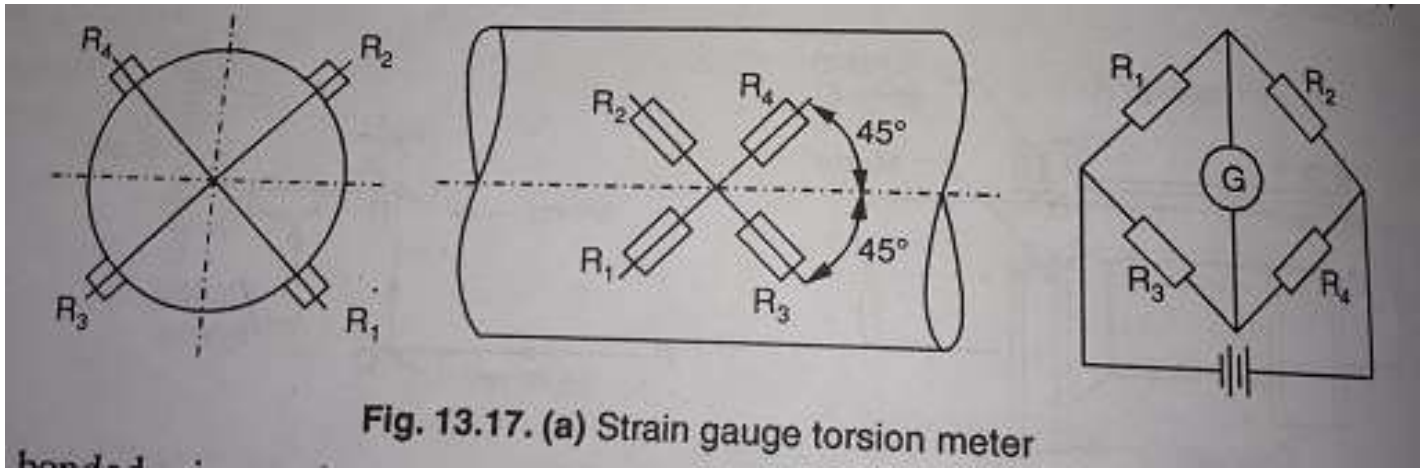


Fig. 13.17. (a) Strain gauge torsion meter

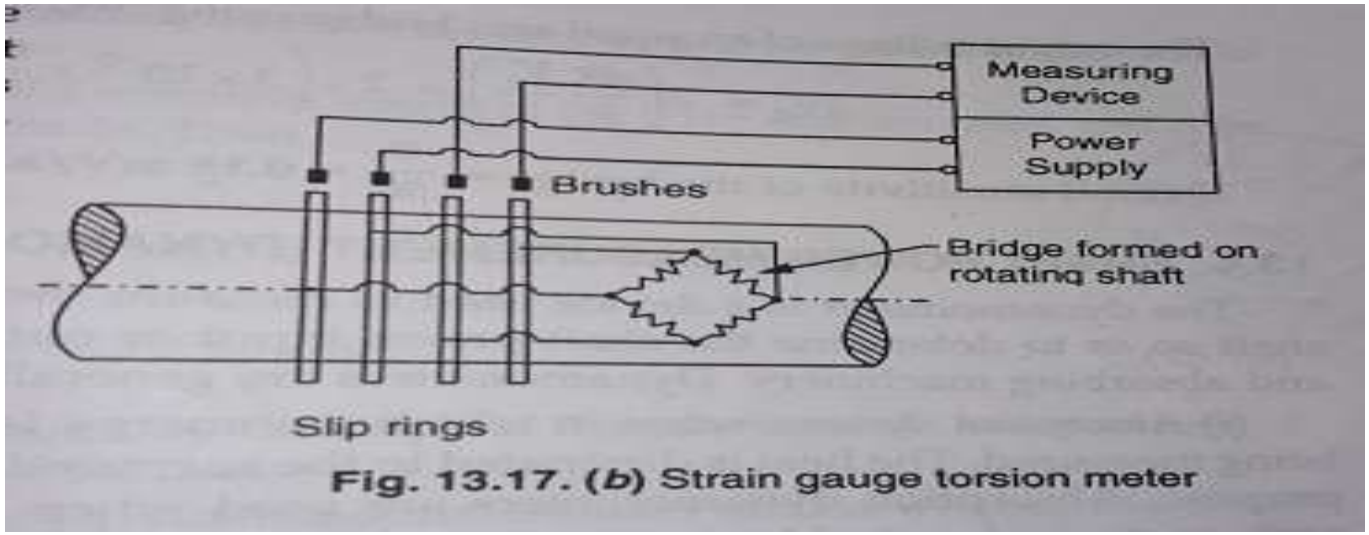


Fig. 13.17. (*b*) Strain gauge torsion meter