The pulleys A and B are connected by means of a continuous belt passing round the two loose pulleys C and D which are mounted on a T-shaped frame. The frame is pivoted at E and its movement is controlled by two stops S,S. Since the tension in the tight side of the belt (T1) is greater than the tension in the slack side of the belt (T2), therefore the total force acting on the pulley C (i.e. 2T1) is greater than the total force acting on the pulley D (i.e. 2T2). It is thus obvious that the frame causes movement about E inthe anticlockwise direction. In order to balance it, a weight W is applied at a distance L from E on theframe as shown in Fig.

$$2T_1 \times a = 2T_2 \times a + W.L \quad \text{or} \quad T_1 - T_2 = \frac{W.L}{2a}$$

Let D = diameter of the pulley A in metres, and

N = Speed of the engine shaft in r.p.m.

$\therefore$ Work done in one revolution = $(T_1 - T_2)\,\pi\, D$ N-m

Torsion Dynamometer

A torsion dynamometer is used for measuring large powers particularly the power transmitted along the propeller shaft of a turbine or motor vessel. A little consideration will show that when the power is being transmitted, then the driving end of the shaft twists through a small angle relative to the driven end of the shaft. The amount of twist depends upon many factors such as torque acting on the shaft (T), length of the shaft (l), diameter of the shaft (D) and modulus of rigidity (C) of the material of the shaft. We know that the torsion equation is

$$\frac{T}{J} = \frac{C.\theta}{l}$$

where θ = Angle of twist in radians, and

J = Polar moment of inertia of the shaft.

For a solid shaft of diameter D, the polar moment of inertia

$$J = \frac{\pi}{32} \times D^4$$

and for a hollow shaft of external diameter D and internal diameter d, the polar moment of inertia,

$$J = \frac{\pi}{32}(D^4 - d^4)$$

From the above torsion equation,

$$T = \frac{C.J}{l} \times \theta = k.\theta$$

Bevis-Gibson Flash Light Torsion Dynamometer

It depends upon the fact that the light travels in a straight line through air of uniform density and the velocity of light is infinite.

It consists of two discs A and B fixed on a shaft at a convenient distance apart, as shown in Fig. Each disc has a small radial slot and these two slots are in the same line when no power is transmitted and there is no torque on the shaft. A bright electric lamp L, behind the disc A, is fixed on the bearing of the shaft.

This lamp is masked having a slot directly opposite to the slot of disc A. At every revolution of the shaft, a flash of light is projected through the slot in the disc A towards the disc B in a direction parallel to the shaft. An eye piece E is fitted behind the disc B on the shaft bearing and is capable of slight circumferential adjustment.

When the shaft does not transmit any torque (i.e. at rest), a flash of light may be seen after every revolution of the shaft, as the positions of the slit do not change relative to one another as shown in Fig. (b). Now when the torque is transmitted, the shaft twists and the slot in the disc B changes its position, though the slots in L, A and E are still in line. Due to this, the light does not reach to the eye piece as shown in Fig. (c).

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