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A single plate clutch, effective on both sides, is required to transmit 25 kW at 3000 rpm. Determine the outer and inner radii of frictional surface, if the co-efficient of friction is 0.255 the ratio of radii is 1.25 and the maximum pressure is not to ex

Question:

A single plate clutch, effective on both sides, is required to transmit 25 kW at
3000 rpm. Determine the outer and inner radii of frictional surface, if the
co-efficient of friction is 0.255 the ratio of radii is 1.25 and the maximum
pressure is not to exceed 0.1 N/mm 2 . Also determine the axial thrust to be
provided by springs. Assume the theory of uniform wear.

Answer:

Solution. Given: $n = 2$; $P = 25$ kW $= 25 \times 10^3$ W ; $N = 3000$ r.p.m. or $\omega = 2\pi \times 3000/60 = 314.2$ rad/s ; $\mu = 0.255$; $r_1/r_2 = 1.25$; $p = 0.1$ N/mm^2

Outer and inner radii of frictional surface

Let r_1 and r_2 = Outer and inner radii of frictional surfaces, and

T = Torque transmitted.

Since the ratio of radii (r_1/r_2) is 1.25, therefore

$$r_1 = 1.25\ r_2$$

We know that the power transmitted (P),

$$25 \times 10^3 = T.\omega = T \times 314.2$$

$$\therefore \quad T = 25 \times 10^3/314.2 = 79.6 \text{ N-m} = 79.6 \times 10^3 \text{ N-mm}$$

Since the intensity of pressure is maximum at the inner radius (r_2), therefore

$$p.r_2 = C \quad \text{or} \quad C = 0.1\ r_2 \text{ N/mm}$$

and the axial thrust transmitted to the frictional surface,

$$W = 2\pi C (r_1 - r_2) = 2\pi \times 0.1\ r_2 (1.25\ r_2 - r_2) = 0.157\ (r_2)^2 \qquad ...(i)$$

We know that mean radius of the frictional surface for uniform wear,

$$R = \frac{r_1 + r_2}{2} = \frac{1.25\ r_2 + r_2}{2} = 1.125\ r_2$$

We know that torque transmitted (T),

$$79.6 \times 10^3 = n.\mu.W.R = 2 \times 0.255 \times 0.157\ (r_2)^2 \times 1.125\ r_2 = 0.09\ (r_2)^3$$

$$\therefore \quad (r_2)^3 = 79.6 \times 10^3/0.09 = 884 \times 10^3 \quad \text{or} \quad r_2 = 96 \text{ mm} \quad \textbf{Ans.}$$

and $$r_1 = 1.25\ r_2 = 1.25 \times 96 = 120 \text{ mm} \quad \textbf{Ans.}$$

Axial thrust to be provided by springs

We know that axial thrust to be provided by springs,

$$W = 2\pi C (r_1 - r_2) = 0.157\ (r_2)^2 \qquad \text{...[From equation (i)]}$$

$$= 0.157\ (96)^2 = 1447 \text{ N} \quad \textbf{Ans.}$$